SCOS97-NARSTO
1997 SOUTHERN CALIFORNIA OZONE STUDY AND AEROSOL STUDY

VOLUME III: SUMMARY OF FIELD STUDY

FINAL REPORT
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SCOS97-NARSTO
Volume III: Summary of Field Study

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Supplemental Measurements of Ozone, Total Oxides of Nitrogen, and Meteorological Parameters at Ground Level			
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Mr. John Collins	Ozonesondes	UC Riverside CE-CERT	ARB ($536K)
Mr. Bill Brick	Rawinsondes	San Diego CAPCD	San Diego CAPCD ($25K)
Mr. William Gibbs	Cessna 182	Gibbs Flite Center	San Diego CAPCD ($82K)
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Aerosols

Supplemental Measurements at Ground Level

Mr. Dennis Fitz	Nitrate & Sulfate	UC Riverside CE-CERT	ARB ($3K)
Mr. Dennis Fitz	Ammonia	UC Riverside CE-CERT	ARB ($3K)
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Dr. Glen Cass	Aerosol Comp	Cal Tech	CRC ($126K) NREL ($127K)
Dr. Susan Hering	Real Time Aerosol	Aerosol Dynamics Inc	CRC ($26K) NREL ($26K)
Dr. Susan Hering	Continuous Nitrate	Aerosol Dynamics Inc	EPRI ($70K)
Dr. Delbert J. Eatough	Organic/Elem Carb	Brigham Young Univ	EPRI ($90K)
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1.0 INTRODUCTION AND BACKGROUND

This document provides a summary of field operations during the 1997 Southern California Ozone Study conducted in coordination with the North American Research Strategy for Tropospheric Ozone partnership (SCOS97-NARSTO). To assemble a synopsis of the field measurement program, policy and technical needs that brought stakeholders to participate in the SCOS97-NARSTO are recalled. Milestones for planning of, managing operations of, and analyzing data from SCOS97-NARSTO are provided to show how these needs have been translated and processed into the elements of the study. Field components are presented to briefly describe how the study elements operated and fit together. The SCOS97-NARSTO Technical Committee and working groups are noted for funding of aerometric field measurement program and for managing the study. An inventory of expected reports from SCOS97-NARSTO participants is also provided as a directory of resources for data analysis and for air quality simulation. It is anticipated that these analyses and simulations would produce data useful to developing better compliance strategy for attainment of ozone and aerosol standards in southern California.

To put the field operations summary into the proper context, the topography and the climatology of southern California is discussed in broad terms. To address ozone and aerosol formation and transport within this complex topography and meteorology, elements of operational intensive periods (IOP's) are defined. Forecasting and deployment decisions for each IOP are described. Summaries of overall observations for each episode day are detailed to characterize these IOP's. It is important to note that the forecasting and the field operations programs were successful in capturing data for the episodes most likely to meet the needs of regional air quality simulation.

Data analysts and air quality modelers would use field measurements to characterize and to simulate the atmospheric chemistry of southern California. Therefore, they have a critical need for detailed descriptions of field measurements during SCOS97-NARSTO. During SCOS97-NARSTO, contractors operated supplemental upper-air meteorological and air quality platforms and ground-level air quality and meteorological stations. Regional air quality districts operated existing surface air quality and meteorological stations and conducted additional measurements at these facilities. Parameters measured at each supplemental site are provided to describe spatial and temporal characteristics of southern California's atmospheric chemistry. Parameters measured at each existing site are available from the United States Environmental Protection Agency's Aerometric Information Retrieval System (AIRS) and appendices A and B Volume I of this document. A SCOS97-NARSTO Atlas with descriptions, photographs, and maps of supplemental study sites is provided on a CD-ROM upon request from the Research Division of the California Air Resources Board (ARB). All supplemental and many existing sites were successfully characterized during SCOS97-NARSTO.

1.1 Background and Issues

The 1990 Clean Air Act (CAA) amendments intended to overhaul the planning provisions for those areas not currently meeting the National Ambient Air Quality Standard (NAAQS). The NAAQS for ozone is exceeded when the daily maximum hourly average concentration exceeds 0.12 ppm more than once per year on average during a three-year period. The California State standard is more stringent: no hourly average ozone concentration is to exceed 0.09 ppm. The CAA identifies specific emission reduction goals, requires both a demonstration of reasonable further progress and attainment, and incorporates more stringent sanctions for failure to attain the ozone NAAQS or to meet interim milestones.

According to the 1990 CAA's classification structure for ozone nonattainment areas, the San Diego area is classified as serious, the Ventura and Southeast Desert areas are classified as severe, and the SoCAB is the only area in the country that is classified as extreme. Serious areas must attain the NAAQS by the end of 1999, severe areas by 2005 or 2007 (depending on their peak ozone concentrations), and extreme areas by 2010. The CAA prescribes minimum control measures for each ozone nonattainment area with more stringent controls required for greater degrees of nonattainment.

Emission reduction plans for ozone precursors in serious, severe, and extreme nonattainment areas are submitted to the U.S. EPA as a revision to the California State Implementation Plan (SIP). Each ozone plan contains a current emissions inventory, plans for enhanced monitoring of ozone and ozone precursors, and estimation of future ozone concentrations based on photochemical modeling. Each plan shows a 9 percent reduction in emissions of reactive organic gases (ROG) between 1996 and 1999, and 3 percent reductions per year thereafter, quantified at three year intervals to the attainment date.

The California Clean Air Act of 1988 requires the California Air Resources Board (ARB) to assess the relative contributions of upwind pollutants to violations of the state ozone standard in downwind areas. Previous studies in California have demonstrated pollutant transport between air basins on specific days, but these studies have not quantified the contribution of transported pollutants to ozone violations in downwind areas. Current air quality simulation approaches have several shortcomings in their representation of the physical and chemical processes involved in ozone formation due to the lack of field measurements to evaluate and refine their capabilities (NRC, 1991). In addition, the field measurements used for input to these models and to evaluate their validity do not adequately represent current emission rates, chemical composition, and air quality. The SCAQS was conducted over a decade ago and the South Central Coast Air Basin (SCCAB) has not been extensively studied since the South Central Coast Cooperative Aerometric Monitoring Program (SCCCAMP) in 1984 and 1985. Since the SCAQS, there have been measurable changes in the air quality of the SoCAB based on analyses of the routinely available monitoring data (Fujita, 1992; Davidson, 1993). The SCOS97-NARSTO is intended to provide another milestone in the understanding of relationships between emissions, transport, and ozone standard exceedances, as well as to facilitate planning for further emission reductions needed to attain the NAAQS.

1.2 Study Goals and Technical Objectives

The goals of the study, recalled from Volume I of this document, are to :

1. Update and improve the existing aerometric and emission databases and model applications for representing urban-scale ozone episodes in southern California

2. Quantify the contributions of ozone generated from emissions in one southern California air basin to federal and state ozone standard exceedances in neighboring air basins. Apply modeling and data analysis methods to design regional ozone attainment strategies.

These goals are to be met through a process which includes analysis of existing data; execution of a large-scale field study to acquire a comprehensive database to support modeling and analysis; analysis of the data collected during the field study; and the development, evaluation, and application of an air quality simulation model for southern California.

Specific technical objectives of SCOS97 are as follows:

1. Obtain a documented data set of specified precision, accuracy, and validity that supports modeling and data analysis efforts.

2. Document the frequency, intensity, and character of high ozone concentrations and its VOC and NO_X precursors within and between neighboring southern California air basins, and determine how these have changed over the past decade.

3. Identify and describe transport pathways between neighboring air basins, and estimate the fluxes of ozone and precursors transported at ground level and aloft under meteorological conditions associated with high ozone concentrations.

4. Quantify the uncertainty of emissions rates, chemical compositions, locations, and timing of ozone precursors that are estimated by emission models.

5. Quantify the uncertainty of meteorological models in simulating transport and mixing of precursors and end-products within and between air basins.

6. Quantify the uncertainty of air quality models in simulating atmospheric transformation and deposition.

7. Provide the meteorological and air quality measurements needed to estimate, with stated uncertainty intervals, the contributions from background, regional mixing and transport, and local emitters to ozone concentrations that exceed standards in each of the air basins.

8. Provide the meteorological and air quality measurements needed to estimate the effects of different emission reduction strategies on ozone concentrations within and

beyond each air basin, and identify those that cause the greatest reduction in population exposure for the least cost.

1.3 Elements of SCOS97-NARSTO

To understand how elements of the study formed a cohesive structure, it is necessary to describe the SCOS97-NARSTO's chronology. The SCOS97-NARSTO Technical Committee (TC), formed early in this chronology, has planned, has directed, has funded, and has managed the study. Working Groups formed from the Technical Committee include the Meteorology, the Air Quality, and the Emission Inventory who, under the guidance of the TC, managed aspects of the study in their respective areas of interest and responsibility. The WGs have been instrumental in preparing and operating the SCOS97-NARSTO. A compressed and concise chronology is provided in Table 1.

In 1993, several air quality management districts in southern California proposed to sponsor the SCOS97 field study to address interbasin transport. In July 1994, the South Coast Air Quality Management District (SCAQMD) hosted an initial planning meeting. The meeting was attended by other districts (Mojave Desert, Santa Barbara County, San Diego, and Ventura County), EPA-Region IX, utilities (Pacific Gas & Electric and Southern California Gas Company), oil companies (Atlantic Richfield Company, Chevron, Texaco and Unocal), industrial research consortiums (Coordinating Research Council and Electric Power Research Institute), and representatives of academia. The TC and WGs were formed to define goals and technical objectives for the proposed study and to provide coordination among sponsoring organizations. Memberships of the working groups are listed in Appendix C of Volume I of this document. A conceptual plan was completed by WGs and approved by the TC in November, 1995. This conceptual plan proposed the study goals and deliverables, the technical objectives, measurement requirements, data analysis activities, and modeling approaches. It is important to note that the planning process began at least two years before the field program, and there was at least one year time to incorporate of the results of pilot studies into the full program plan.

The SCOS97 conceptual plan (ARB, 1995a) provided the basis for the June 1996 draft of the field study plan (Fujita et al., 1996). The draft field study plan matched the SCOS97 goals and objectives with the resources available to do the job, and specified the details of the field study plan that would allow the conceptual plan to be executed. This version of the field study and quality assurance plan reflects the final stages of the planning process for the SCOS97-NARSTO Field Study. The overall design process was iterative and the final plan incorporated input from sponsors, other stakeholders, knowledgeable peer reviewers, and users of the data.

1.0 In further preparation for SCOS97-NARSTO, sponsors executed pilot studies such as the Barstow Halocarbon Study by the Desert Research Institute (DRI). This study in 1994, 1995, and 1996 investigated patterns of air pollution transport between the South Coast air basin and the Mojave and the Saltan Sea air basins. The 1995 Air Pollution Transport Corridors study further investigated the three dimensional nature of this inter-basin transport by employing additional supplemental ozone and meteorological sites and by using an instrumented airplane and a scanning ozone light detection and ranging (lidar) instrument. This study marked the first deployment of a scanning ozone lidar in California. Both these pilot studies contributed to our knowledge of the most important sites and times to characterize and to monitor these interbasin air pollution transport couples and the siting of many SCOS97-NARSTO supplemental ozone sites. The Upper-Air Ozone Measurement Intercomparison Study at Walnut Grove and at Sandia National Laboratory allowed comparison of data from and evaluation of an ozonesonde, an instrumented aircraft, and an ozone lidar (Sandia) that was originally designed for monitoring atmospheric water content. A scanning ozone lidar, a lidar operating in generally the same manner as the Sandia lidar [operated for only two weeks], ozonesondes, and instrumented airplanes provided the primary air quality data aloft during SCOS97-NARSTO intensive operational periods.

In a preliminary effort, the emission inventory WG reviewed and corrected a Systems Application International (SAI) produced 1990 base emission inventory sponsored by ARB. This base inventory would then be used to develop a gridded 1996 base emission inventory which would then be grown into a 1997 gridded emission inventory. This emission inventory system would then be ready to integrate the day specific emission inventory data collected during SCOS97-NARSTO. To investigate ship borne emissions, the United States Navy planned and executed a pilot study on ship traffic into and out of the southern California bight. Members of the emission inventory WG have asked major sources in their domains for day-specific information and nearly sixty percent have already provided such data. Under contract to ARB, University of California Davis collected light-duty vehicle and heavy-duty truck traffic counts as inputs for traffic models. Depending on the release of growth factors and other related information from the Southern California Association of Governments, it is estimated that the emission inventory process would meet the air quality modeling chronology.

All three WGs put significant emphasis in selecting their QA programs and the TC selected the DRI as the overall SCOS97-NARSTO QA manager. The speciated hydrocarbon and carbonyl sampling QA relied on round-robin interlaboratory and intermethod comparisons. Whenever possible different measurement methods were collocated to permit comparisons for estimating accuracy and validity of the data. These measurements included ozone from lidar and from instrumented airplanes, PAN, NO_y, aerosols, radiation, and upper air meteorology. The meteorology WG planned and executed an extensive program of system and performance audits for upper air meteorology, which will be discussed in detail later. For nitric acid, the tunable diode laser spectroscopic was used as a "reference" method. Data archival has been emphasized as an integral part of the overall study and will be sited at ARB Technical Support Division. Data reporting conventions, site documentation, and units have been established and communicated to the study participants. Extensive data management and "Level 2" data validation for the upper-air meteorology, air quality aloft, speciated hydrocarbon and carbonyl, and NOY data has been planned.

On May 15, 1997, SCAQMD hosted the Measurement Coordination Meeting where intensive operational period (IOP) protocols and data exchange agreements were discussed and approved. Program management and quality assurance issues were resolved at this meeting. The SCOS97-NARSTO field operations program began on June 16 and ended on October 15, 1997. Due to the El Niño driven climatology and the introduction of federal and California reformulated gasolines, the conditions for formation of high ozone episodes were less robust than during the 1993 Los Angeles Free Radical Study. Nevertheless, high ozone conditions were observed on July 3 [a non-IOP day due to unusual emission patterns], August 4 to 7, 22 to 23, September 3 to 6, 22 to 23, and 27 to 29, 1997. More detailed description of the IOP days are provided in the section 2.5 of this document.

To prepare for the upcoming State Implementation Plan 2000 for ozone and aerosols, early emphasis will be on airshed modeling of the SCOS97-NARSTO data. SCAQMD has sponsored Sonoma Technology, Inc (STI) to provide guidance, inputs, and data for evaluation of emissions, meteorological, and photochemical models, as part of the air quality management plan process. This project will also validate the SCOS97-NARSTO speciated hydrocarbon and carbonyl data and determine the air quality and meteorological representativeness of the SCOS97 episodes. ARB Research Division would conduct more observation-based analyses of upper-air quality and the NO_Y data. This group would also conduct observation-based and receptor modeling analyses on the data from the Aerosol Study during SCOS97-NARSTO. The summary and preliminary analyses of the SCOS97-NARSTO results will be presented at the 1998 Air and Waste Management Association's 91st Annual Meeting in San Diego, California. A Data Management and Analysis Plan will be prepared and presented to the TC in August of 1998. The University of California Los Angeles will host the SCOS97-NARSTO Data Analysis Symposium in June of 1999. Selected papers from this symposium will be combined in the SCOS97-NARSTO issue of Environmental Science and Technology. The SCOS97-NARSTO data will likely provide the basis for air quality scientific inquiry and air pollution policy in southern California for the next decade.

The SCOS97-NARSTO benefited from a communication system that heavily relied on the world wide web for disseminating IOP decisions, meteorological and air quality forecasts, and during the study even provided upper-air meteorological profiles from selected sites in a timely manner. Traffic count updates and other real-time resources describing conditions in southern California were also available to study participants through the world wide web. A list of selected SCOS97-NARSTO related sites is provided in Table 2 of this document. These sites provide information, reports, and data connected with the SCOS97-NARSTO. For information on SCOS97-NARSTO level II data's future release times and exchange protocol, it is recommended that the ARB Research Division site be monitored.

1.4 Components of the SCOS97-NARSTO Field Study

Since Dr. Haagen Smit explained the basic nature of photochemical smog in 1952, research in the laboratory and the real world has focused on better understanding the nuances of the complex photochemical processes that occur in our atmosphere. But, routine monitoring for many of the "exotic participants" in the photochemical reactions such as peroxy acetyl, proxy propionyl, and other organic nitrates is outside our technical and/or financial resources. Other "exotic participants" such as isoprene, and other biogenic emissions, and product of their atmospheric oxidation by free radicals, until recently, had not been measured in real-time. Even basic building blocks of atmospheric chemistry of ozone and aerosols such as nitrogen dioxide, hydroxyl radical, nitric acid, and ammonia are extremely difficult to measure directly and in real time with sufficient sensitivity, accuracy, and precision. Major field studies are occasionally conducted with components specifically designed to measure these "exotic participants" so that we may learn the details of the atmospheric processes and how we may need to change emissions in the future to attain healthful air for the residents of California.

Ironically, many of these field studies (which take years to plan) unintentionally occurred during years when air pollution levels were lower than normal. No matter the meteorological conditions, the process of improving air quality relies on conducting field studies and incorporation the results into the planning process for controlling emissions. The SCOS97-NARSTO was also "plagued" by good meteorology when the smog season of 1997 (the cleanest season on record) produced only one Stage One ozone episode (1-hour concentration 20 pphm)--in contrast to seven, 14, 23, 24, and 41 during the prior five years. The good dispersion of pollutants during this study (which included the effects from three hurricanes in the study area) is generally credited to the well-publicized El Niño.

The field study portion of SCOS97-NARSTO was designed to maximize the chances of capturing high ozone episodes and to fill in the "holes" in our knowledge uncovered by previous studies.

Five types of ozone episodes in southern California were of interest. The study was successful in capturing all of the episode types except one (Type 5--Offshore Transport to San Diego). This last episode type was partially captured because it did occur two weeks after the study officially ended while certain SCOS97-NARSTO monitoring resources were still operational.

Remote sensing methods were employed to continuously monitor meteorological conditions aloft throughout the study period of June 16 through October 15. Previous studies provided only limited characterization of meteorological conditions aloft (with balloons and aircraft deployed during periods forecast to have high ozone concentrations) and this severely hampered the analyses of data in this area of complex meteorology and topography. In SCOS97-NARSTO, a network of 35 remote sensing systems was established (the densest network of radar wind profilers and sodars ever assembled) to continuously monitor wind and temperature conditions aloft throughout and around the South Coast Air Basin. During periods when high ozone concentrations were forecast, additional measurements on conditions aloft were obtained by means of ozonesonde releases at seven sites, rawinsonde releases at thirteen sites, six aircraft, and two lidars; in all, over 1,000 balloons were released during the study. At over 20 surface monitoring sites and on three aircraft, volatile organic compounds were sampled. These additional measurements provide critical detailed information pertinent to running and validating air quality models.

Because previous modeling efforts underestimated the amount of ozone in the central basin where ozone concentrations tend to be highest, the El Monte Airport, near the center of the basin, was established as the hub site for enhanced monitoring. An ozone lidar and a radar wind profiling system (RWP) were operated nearly continuously during the intensive periods to identify the dynamics of ozone and meteorological conditions with height and time. These data were supplemented by measurements of ozone, oxides of nitrogen, temperature, humidity, and particles on up to nine aircraft spirals during daylight hours.

Previous studies demonstrated the complexity of air circulation over the southern California bight and how important it is to adequately characterize the offshore meteorological conditions and air quality. Air quality and meteorological monitoring offshore were greatly enhanced for the SCOS97-NARSTO which included sites on San Clemente, San Nicolas, Santa Catalina, and Santa Rosa Islands as well as at eight new coastal locations; measurements of conditions aloft were taken at eight of the dozen sites. During intensive operational periods, an instrumented aircraft (making morning and afternoon flights) provided additional, detailed data on conditions in the southern California bight during over-water sampling in an elliptical path encompassing the islands. On occasion, a second aircraft mapped the distribution of ozone concentrations inside the northeast quarter of the ellipse by sampling over the ocean west and southwest of Santa Monica Bay.

An important objective of SCOS97-NARSTO was to understand why ozone levels are improving at a slower rate on weekends than weekdays, the so-called "weekend effect." For the first time, detailed information (over 300 megabytes of data a day) was collected on the operations of cars, trucks, airplanes, ships, and major point sources every day for four months. This data will be analyzed to determine the differences in pollutant emissions on weekdays and weekends. Also, day-specific biogenic hydrocarbon emissions inventories are being assembled for comparison with the anthropogenic emissions.

An aerosol component of the study collected detailed data on the size distribution of particles at ground level and aloft. Real time measurements were also made of particles at some ground level sites. Size and composition information on over two million individual particles were collected during at least ten different types of fine particle episodes. Despite a shoestring budget, a wide variety of simple and sophisticated solar radiation instruments were brought to the study for evaluation of the sensitivity of ozone formation to both the radiation absorbing and scattering properties of particles. During another component of the study, releases of up to five different tracers were made to simulate emissions from shipping channels. This information will be used to compare how ship emissions from the current and proposed shipping lanes might impact air quality when they come on-shore.

Despite the cleanest air quality on record for the study area, the team of forecasters successfully predicted the days with the second and third highest concentrations (the day with the highest concentration of the year was not of interest because it occurred on July 3 after several days of forest fires and when traffic patterns were likely atypical due to the holiday weekend).

Although the monitoring phase of SCOS97-NARSTO is over, much work remains as the study participants attempt to fully utilize the data collected and address the informational needs of the study sponsors. This study will provide the first detailed analyses of the causes contributing to violations of the new national 8-hour ozone and 24-hour PM2.5 standards. The data collected will be used in modeling and data analyses that will provide the most definitive answers yet to solving the persistent air quality problems in a complex region. The cooperation of the study sponsors (U.S. EPA, local air pollution control districts, U.S. Marine Corps, U.S. Navy, National Renewable Energy Laboratory, Coordinating Research Council, EPRI, Southern California Edison, and ARB) in integrating and "piggybacking" projects made it possible to leverage the available funds for maximum scientific benefit.

1.5 Sponsors and Management

SCOS97-NARSTO has been a large undertaking involving many contractors, sponsoring organizations and governmental agencies. In a cooperative study such as this, no one person can have direct management authority over all phases of the study. Since direct fiscal responsibility will remain with the California Air Resources Board (ARB), South Coast Air Quality Management District (SCAQMD), San Diego Air Pollution Control District (SDAPCD), Ventura County Air Pollution Control District (VCAPCD), Mojave Desert Air Quality Management District (MDAQMD), United States Navy, Coordinating Research Council (CRC), the management structure for SCOS97-NARSTO reflects this consortium of sponsors. The setting for the development and progress of this consortium has been the SCOS97-NARSTO Technical Committee. A list of study personnel and supporting organizations is provided in the preamble to this volume. Lists of in-kind support are provided in specific measurement categories in the Volume I of this document.

The Technical Committee (TC) has set the goals of the study and has made decisions regarding general study objectives, funding, and selection of contractors. The TC is made up of technical staff members from ARB (Research and Technical Support Divisions), SCAQMD, SDAPCD, VCAPCD, Santa Barbara APCD, MDAQMD, EPA-Region IX, United States Marines, and United States Navy. The TC has directed the planning efforts and has coordinated the technical activities of the contractors to ensure that the measurement, emission, modeling, and analysis activities are coordinated with each other and focused on the study objectives. A list of the TC members is provided in Appendix C of Volume I, The Operational Program Plan, of this document.

The Meteorology Working Group was primarily responsible for the largest and the most dense network of upper-air meteorological measurements ever assembled in southern California. This network included 28 Radar Wind Profiler and Radio Acoustic Sounding Systems (RWP-RASS), 7 Sound Detection and Ranging Systems (sodars), rawinsonde launches from 13 launch sites, and meteorological data associated with ozonesondes from 7 launch sites. The rawinsonde launches were restricted to 4 times daily during intensive operational periods. The MWG was also primarily responsible for the success of system and performance audits conducted during the study to assure the highest quality meteorological data was collected during SCOS97-NARSTO. MWG leaders have come from ARB (Bruce Jackson – co-chair and Steve Gouze), from SCAQMD (Joe Cassmassi – co-Chair and Kevin Durkee), from SDAPCD (Bill Brick and Virginia Bigler-Engler), from VCAPCD (Kent Field), and from U.S. Navy (Roger Helvy and Jay Rosenthal).

The Air Quality Working Group is primarily responsible for developing, operating, and managing the first total reactive nitrogen species (NO_Y) network in southern California and the ozone sites supplemental to the Routine Network. Supplemental ozone sites are sites operated specially for SCOS97-NARSTO or are sites whose data have not been routinely submitted to AIRS. State and Local and National Air Monitoring Stations (SLAMS and NAMS) data are routinely submitted to AIRS. This, Routine Network, collects aerometric data including ambient concentrations of gases such as ozone, oxides of nitrogen, sulfur dioxide, carbon monoxide, methane, and ambient meteorological parameters such as temperature, relative humidity, wind parameters, pressure, radiation, and aerosols data such as particulate matter less than 10 micron in aerodynamic size (PM10). During 1998 and later, many sites in this Routine Network will also collect PM less than 2.5 micron in aerodynamic size (PM2.5 or PM Fine) data. The quality of the data and what parameters are collected vary considerably from site to site. This is primarily due to regional district's resources and their ozone and aerosol attainment demonstration status. It is important to understand that to a certain extent the NO_Y, the speciated hydrocarbon and carbonyl (VOC), and the aerosol networks were essentially superimposed on existing Routine Network. The Routine Meteorological Network includes the aerometric stations, as well as those stations operated by the National Weather Service, National Park Service, and fire safety and prevention concerns. Types of SCOS97-NARSTO sites are discussed in detail in section 3.1 of this volume.

The VOC network improved the spatial and temporal extent and data quality assurance of the Photochemical Assessment Monitoring Stations (PAMS) at 20 stations in the SCOS97-NARSTO domain. The NO_Y network operated at 14 sites, five were new sites where ozone and meteorological parameters were also measured. There were 31 supplemental ozone sites during SCOS97-NARSTO. It is important to note that there were supplemental stations that collected ozone, aerosol, and NO_Y data simultaneously. It is also important to note that some supplemental stations, those in the Children's Health Study Network, are operated year-around and on a semi-permanent basis.

The study's Field Program Management Committee (FPMC) provided the day-to-day technical management during the field study. The FPMC made decisions regarding intensive operation periods, and contingency funding. This committee included a single representative from the ARB Research Division (Bart Croes), ARB Research Division (Don McNerny), SCAQMD (Henry Hogo), SDAPCD (Judy Lake - Chair), VCAPCD (Doug Tubbs), U.S. EPA (Carol Bohnenkamp), U.S. Navy (Jay Rosenthal).

The forecast team developed the Forecast Plan in conjunction with the field manager, reviewed meteorological data, and provided consensus forecasts to the FPMC. The forecast team also documented the daily meteorological conditions during 1997. This team included a single representative from the ARB (Steve Gouze), SCAQMD (Joe Cassmassi – Chair), SDAPCD (Virginia Bigler-Engler), VCAPCD (Kent Field), and U.S. Navy (Jay Rosenthal).

The Field Managers coordinated the activities of the field contractors (in-kind personnel will be under the direction of their management/FPMC members). Jim Pederson (upper-air meteorology), Leon Dolislager (air quality), Dr. Ash Lashgari (surface meteorology, ozone and NOy) and Dr. Randy Pasek (VOC) of the Air Resources Board Research Division were the FMs and the main contact points to relay information on measurement readiness status during and between the intensive operational periods (IOPs). Mr. Bart Croes of the Research Division coordinated their activities and provided day-to-day communication and leadership support.

The Quality Assurance manager has been responsible for developing the QA plan in conjunction with the field managers and field contractors. The QA manager supervised the systems and performance audits and reported their results to the field manager and field contractors. The QA manager has worked with the data manager to develop quality assurance data screening protocols and has managed the data quality assurance efforts. Dr. Eric Fujita of the Desert Research Institute has been the QA manager and has reported to the SCOS97 Technical Committee.

The Data Manager is responsible for developing the data management plan in conjunction with the field managers and field contractors. The data manager works with the field manager, measurement contractors, modelers, and analysts to develop standard data formats for use in the study. The data manager is responsible for obtaining project data and supplemental data, integrating the data into a common database, performing Level 1 screening of the data, providing the data to the QA, analysis, and modeling contractors, and documenting and maintaining the data archive. Mrs. Liz Niccum of the Air Resources Board Technical Support Division has been designated the data manager.

The data management process is the beginning of the analysis and modeling of SCOS97-NARSTO data set. This process would soon lead to the availability of this massive data set to the community of atmospheric scientists.

1.6 Guide to Study Reports

To better understand this data set and to be able to focus the scientific inquiry into diverse aspects of the SCOS97-NARSTO, it is important to note what reports are, and would be, available to guide any search for relevant data. Volume I and III of this document are particularly useful for planning of future studies such as the San Joaquin Valley Study 2000 or other studies with limited focus on aerosols, on nitrogen species measurements, and on radiation issues. Volume II reflects the SCOS97-NARSTO QA approach, which would be useful to understand the outlines of the QA program in each particular area and SCOS97-NARSTO innovations on how specific QA programs would be designed. This volume, IV, serves to high light particulars of SCOS97-NARSTO field operations; this volume is useful to focus on particular IOP's and the measurements of particular relevance during each IOP of interest. Volume V documents actual QA practices to guide the selection of what information are abstracted from the data set.

Other upcoming reports from contractors who participated in the SCOS97-NARSTO field program are listed in Table 3. It is important to note that this list would likely be updated and made part of the SCOS97-NARSTO ARB Research Division internet site.

Table 1
SCOS97-NARSTO CHRONOLOGY

Date	Milestone
September 1993	RSC meeting - Present planning RFP
December 1993	RFP released
February 1994	Responses received
March 1994	RSC Meeting - Planning RFP awarded to DRI
July 1994	Concept Meeting at South Coast AQMD - Formation of TC
January 1995	Feasibility study for a southern California Air Quality Monitoring Study. Report prepared by SAI for CRC
May-October 1995	Pilot studies - Barstow Halocarbon Study, ozone aloft monitoring, and scanning lidar evaluations
November 1995	Conceptual Plan for SCOS97-NARSTO prepared by the TC and WGs
June 1996	Draft SCOS97 Field Study Plan prepared by DRI with input from TC and WGs
August 1996	Preliminary regional meteorological modeling
October 1996	SCOS97 sponsors release RFPs
December 1996 -March 1997	Contracts in place
April 1997	Draft SCOS97-NARSTO Quality Assurance Plan prepared by DRI with input from TC, WGs, and measurement contractors
May 1997	Measurement Coordination Meeting
June 1997	Final SCOS97-NARSTO Field Study and Quality Assurance Plan prepared by DRI with input from TC, WGS, and measurement contractors
June 16, 1997 to October 15, 1997	Conduct SCOS97-NARSTO field study
May 1998	RSC Meeting – Present Operational Plan, Quality Assurance Plan, Aerosol Study Field Plan, Summary of Field Operations, Summary of Quality Assurance
June 1998	Complete assembly and validation of data archive
June 1998	SCOS97-NARSTO symposium I – AWMA 91st Annual Meeting – Review of field study and preliminary interpretation of data
August 1998	TC Meeting – Present Data Management and Analysis Plan
March 1999	Complete data analysis
June 1999	Regional meteorological modeling evaluation and emission inventory due for the SIP process
June 1999	SCOS97-NARSTO symposium II – ES&T Special Issue – Data Analysis
January 2000	Regional air quality model evaluation due for the SIP process
June 2000	Regional control strategy assessment due for the SIP process

Table 2
SCOS97-NARSTO WORLD WIDE WEB SITES

Source	Address
ARB	http://arbis.arb.ca.gov/homepage.htm
ARB	http://www.arb.ca.gov/scos/scos.htm
ARB Monitoring Sites	http://arbis.arb.ca.gov/aqd/ozone/lst1_ste.htm
NOAA	http://www7.etl.noaa.gov/programs/SCOS97/
NOAA	http://www4.etl.noaa.gov/index.html
DRI	http://www.dri.edu/EEEC/Faculty/Fujita.html
CE-CERT	http://cert.ucr.edu/~macm/
CE-CERT	http://www.cert.ucr.edu/ap/air.html
U.S. Navy	http://www.enviro.navy.mil/
U.S. Navy	http://web.nps.navy.mil/~cirpas/past_proj.html
Santa Barbara CAPCD	http://www.silcom.com/~apcd/ota/mayjun97.htm
South Coast AQMD	http://www.aqmd.gov/scos97/
South Coast AQMD	http://www.aqmd.gov/news/smog97_1.html
UCLA	http://www.ph.ucla.edu/ese/w_rsrch.htm
EPA	http://www.epa.gov/region09/air/
EPA	http://www.epa.gov/region09/air/sip/casip3.html
Mojave Desert AQMD	http://www.mdaqmd.ca.gov/
San Diego CAPCD	http://www.sdapcd.co.san-diego.ca.us/scos97.html
U.S. Dept of Energy	http://www.doe.gov/
CRC	http://crcao.com/
Cal Trans	http://www.scubed.com/caltrans/

Cal GAP Project	http://www.biogeog.ucsb.edu/projects/projects.html
NARSTO	http://odysseus.owt.com/Narsto/1998NewsletterWS.pdf
PSU	http://horizons.sb2.pdx.edu/~fage/
CIMIS	http://wwwdpla.water.ca.gov/cimis/cimis/hq/
NWS	http://nimbo.wrh.noaa.gov/wrhq/profile.html
NPS	http://www.aqd.nps.gov/ard/
NPS ARD	http://www.aqd.nps.gov/ard1/
NPS IMPROVE	http://www.aqd.nps.gov/ard1/investhp.html

Table 3
GUIDE TO STUDY REPORTS

Contractor	Number	Expected Date	Sponsor	Title
SJSU- Bob Bornstein Penn State- Nelson Seaman	97-310	July 2000	ARB-RD	*Improvement and Evaluation of the Mesoscale Meteorological Model MM5 for Air Quality Applications in Southern California and the San Joaquin Valley*
UC Berkeley- Rob Harley	96-335	December 99	ARB-RD	*Review and Improvement of Methods for Estimating Rates of Photolysis in Photochemical Models*
UC Riverside- CE-CERT-Dennis Fitz	96-504	September 98	ARB-RD	*Measurement of Nitrogenous Species & Solar Intensity During SCOS97*
NOAA-Yanzeng Zhao	95-337	December 98	ARB-RD	*Measurement of Ozone Concentrations Aloft During the Episodic Monitoring Periods of the SCOS97*
STI-Don Blumenthal	96-309	November 98	ARB-RD	*Investigation of Processes Leading to the Formation of High Ozone Concentrations Aloft in Southern California*
UCD- John Carroll	95-332	September 98	ARB-RD	*Aircraft Measurements in Support of SCOS97*
U.S. Navy, Naval Facilities Engineering Service Center-Norm Helgeson	97-304	October 98	ARB-RD	*Measurements of Ozone and Meteorological Conditions in the Low Atmosphere During SCOS97*
California Institute of Technology-John Seinfeld	96-315	February 99	ARB-RD	*Aircraft Sampling to Determine Atmospheric Concentrations & Size Distributions of PM & Other Pollutants over the SoCAB*
UC Riverside - CE – CERT-Dennis Fitz	96-322	November 98	ARB-RD	*Surface and Upper-Air VOC Sampling and Analysis During SCOS97*
NoAA-Bob Weber	96-323	October 98	ARB-RD	*Management of Data from the Upper-Air Meteorological Network for SCOS97*
AeroVironment- Bob Baxter	96-320	August 98	ARB-RD	*Audit of Radar Wind Profiler Network and Selected Surface Meteorological Sites for the SCOS97*
AeroVironment- Bob Baxter	96-320	August 98	ARB-RD	*Addendum to the final QA report, soundings made by the ARB and the U. S. Navy for QA purposes at 12 radar wind profiler sites will be compared with radar wind profiler soundings*
NOAA-William Neff	95-345	March 99	ARB-RD	*Enhancement of the Existing Radar Wind Profiler Network for SCOS97*
UCLA- Arthur Winer-Proposal	2354-202	June 2000	ARB-RD	*Development and Validation of Databases for Modeling Biogenic Hydrocarbon Emissions in California's Airsheds*
UCLA- Arthur Winer	95-309	September 98	ARB-RD	*Biogenic Hydrocarbon Inventories for California: Generation of Essential*

				Databases
Radian/STI- George Frederick	96-318	May 99	ARB-RD	*Enhancement of the Existing Radar Wind Profiler Network for SCOS97*
SAI-Julie Fieber	974-734	March 97	ARB-TSD	*Preparation of a Draft 1990 Gridded Emission Inventory for Southern California*
RFP	97-715	June 2000	ARB-TSD	*Develop SCOS-97 NARSTO Gridded Emission Inventories*
AeroVironment- David Pankratz	96-719	September 98	ARB-TSD	*Supplemental Monitoring for Recirculation Patterns in the SoCAB*
UC Riverside - CE -- CERT- Dennis Fitz	95-723	September 98	ARB-TSD	*Performing Ozonesonde Measurements for the SCOS97*
STI-Paul Roberts	-	July 99	SCAQMD	*PAMS and SCOS97 Data Analysis Project*

2.0 SYNOPSIS OF THE SCOS97-NARSTO FIELD MEASUREMENT PROGRAM

2.1 Study Scope

There are seven air basins in the SCOS97 domain (shown in Figure 2-1): the San Joaquin Valley (southern part of Kern County only), South Central Coast (Ventura County, Santa Barbara County and southern portion of San Luis Obispo County), South Coast, San Diego, and Mojave Desert and Southeast Desert Air Basins (abbreviated SJVAB, SCCAB, SoCAB, SDAB, and SEDAB, respectively). The study area includes about 53,000 square miles in the southern portion of the State, with a population of more than 18 million. Seven percent of the entire U.S. population, and more than half the population of California, live in the South Coast Air Basin alone. This region of California is an area of complex terrain (see Figure 2-2) — bounded by the Pacific Ocean to the west; to the north by narrow coastal mountains and valleys, the San Joaquin Valley, and the Sierra Nevada Mountains; and to the south and east by the California state border. Although the air basin boundaries were established with topographical features in mind, winds can and do transport pollutants from one basin to another.

The study dates were June 16 to October 15, 1997. The measurements to be made each day throughout the four-month study period included:

- Activity data for freeway traffic, major point sources, commercial and naval ships, commercial aircraft, and wildfires;
- Vertical profiles of winds and temperature from radar wind profilers with radio acoustic sounding systems (RWP/RASS) or SODARs at 32 sites;
- Vertical profiles of winds, temperature, and humidity from rawinsondes 1 or 2 times per day at 4 to 8 sites (depending on the day of the week);
- Speciated volatile organic compound (VOC) sampling every third day (2, 4, or 8 times a day) at 11 sites, and daily analysis 8 times a day at Burbank and Pico Rivera;
- Total reactive nitrogen (NO_y) at 14 sites and nitric acid (by difference) at 10 of those sites;
- Ozone and meteorology at 31 supplemental sites;
- Ozone, total nitrogen oxides (NO_X), and meteorology at 96 existing Air District sites;
- Surface meteorology at over 200 existing sites;
- Specialty radiation at Mt. Wilson and UC Riverside; and
- Total solar radiation at 78 existing sites.

During the month of September, additional continuous measurements include:

- Vertical profiles of ozone, aerosol extinction, temperature, and humidity from a lidar at Hesperia;
- Speciated VOC analysis 24 times a day at Azusa; and
- Hydroxyl and hydroperoxyl radicals, speciated VOC analysis, ozone, NO_X, CO, aerosol size, and ultraviolet radiation at UC Riverside.

Measurements to be made only during IOPs include:

- Vertical profiles of winds, temperature, and humidity from rawinsondes 4 times per day at 11 sites;
- Vertical profiles of ozone and aerosol extinction from a lidar at El Monte Airport;

- Air quality and meteorology aloft from 4 full-time and 2 part-time aircraft;
- Vertical profiles of ozone, temperature, and humidity from ozonesondes 4 times per day at 7 sites;
- Speciated VOC sampling at 25 sites, and aboard 4 aircraft;
- Halocarbons at 6 sites;
- Biogenic hydrocarbon and methylnitronapthalene sampling at 3 sites;
- Specialty nitrogen and VOC at Azusa;
- Peroxyacetyl nitrate (PAN) at 4 sites with peroxypropyl nitrate (PPN) at 2 of the sites; and
- Real-time single particle size and chemical composition at 3 sites.

Three additional studies are being conducted in coordination with the main SCOS97-NARSTO study described above:

- Aerosol program to be conducted between August 16 and September 14. It includes surface street traffic counts at 12 sites, state-of-the-art particle measurements at 3 sites, and a specially instrumented airplane along two separate air trajectories in the SoCAB (see Appendix A for a more complete description).

- Additional specialty radiation measurements at Mt. Wilson and UC Riverside during June 29 to July 5 and the first IOP between September 2 and 12.

- Tracer study with off-shore releases of 5 different perfluorocarbons during four 2-day periods between August 15 and October 15.

2.2 Study Area Climatology

Given the primary emissions within the complex terrain of southern California, it is the climate of southern California that fosters generation of ozone, a secondary pollutant. High ozone concentrations most frequently occur during the "ozone season," spanning late spring, summer, and early fall when sunlight is most abundant. Meteorology is the dominant factor controlling the change in ozone air quality from one day to the next. Synoptic and mesoscale meteorological features govern the transport of emissions between sources and receptors, affecting the dilution and dispersion of pollutants during transport and the time available during which pollutants can react with one another to form ozone. These features are important to transport studies and modeling efforts owing to their influence on reactive components and ozone formation and deposition..

Southern California is in the semi-permanent high pressure zone of the eastern Pacific. During summer, average temperatures are ~25 °C, with maximum daily readings often exceeding 35 °C. Precipitation events are rare. Frequent and persistent temperature inversions are caused by subsidence of descending air which warms when it is compressed over cool, moist marine air. These inversions often occur during periods of maximum solar radiation which create daytime mixed layers of ~1,000 m thickness, though the top of this layer can be lower during extreme ozone episodes (Blumenthal *et al.*, 1978). Relative humidity depends on the origin of the air mass, proximity to the coast, altitude, and the time of day, and can exceed 50 percent during daytime throughout the SoCAB with the intrusion of a deep marine layer. Relative humidity is higher near the coast than farther inland (Smith *et al.*, 1984a).

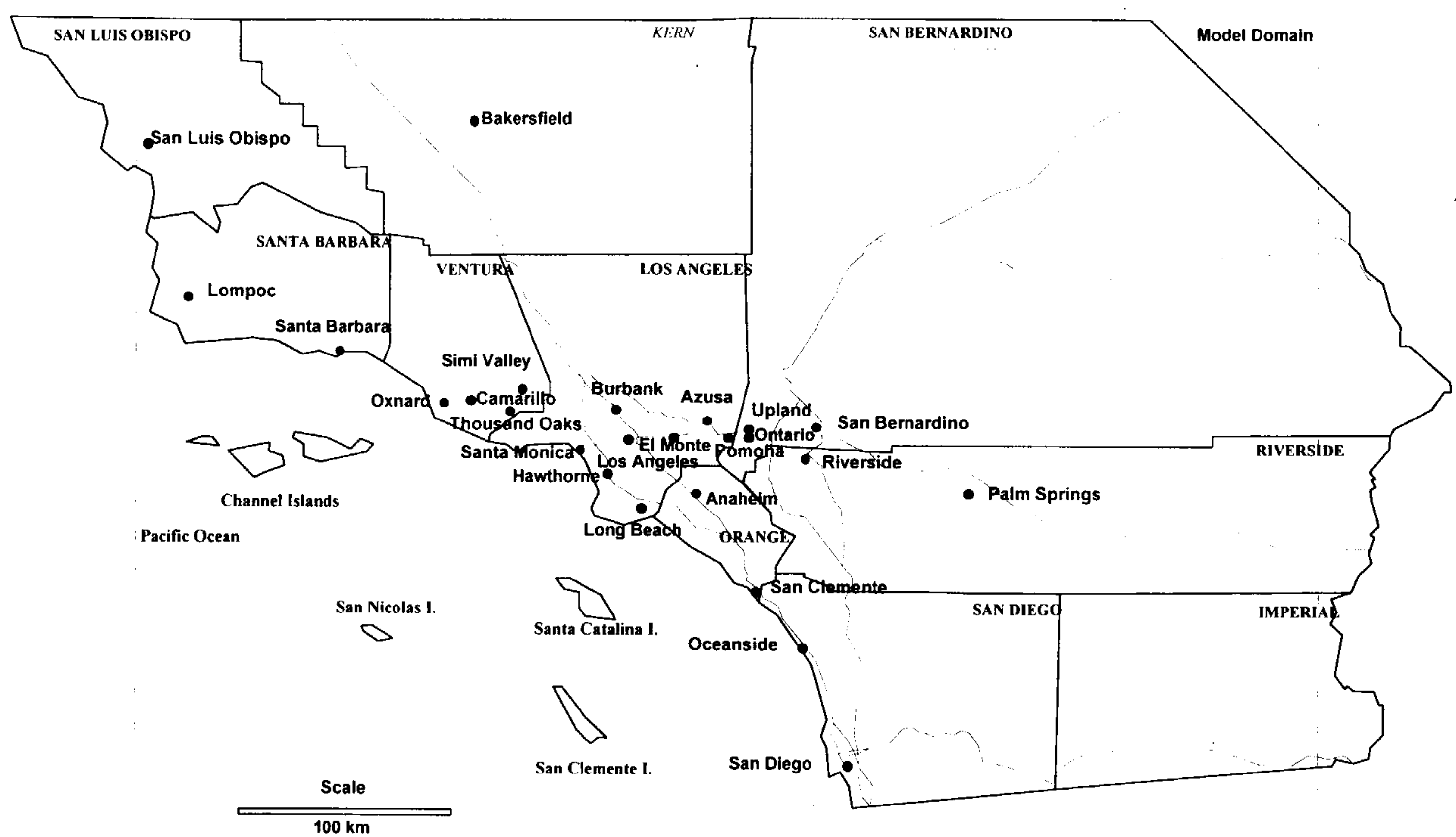

Figure 2-1. The SCOS97-NARSTO study area. Major cities, county boundaries, interstate highways, and the proposed modeling domain are shown.

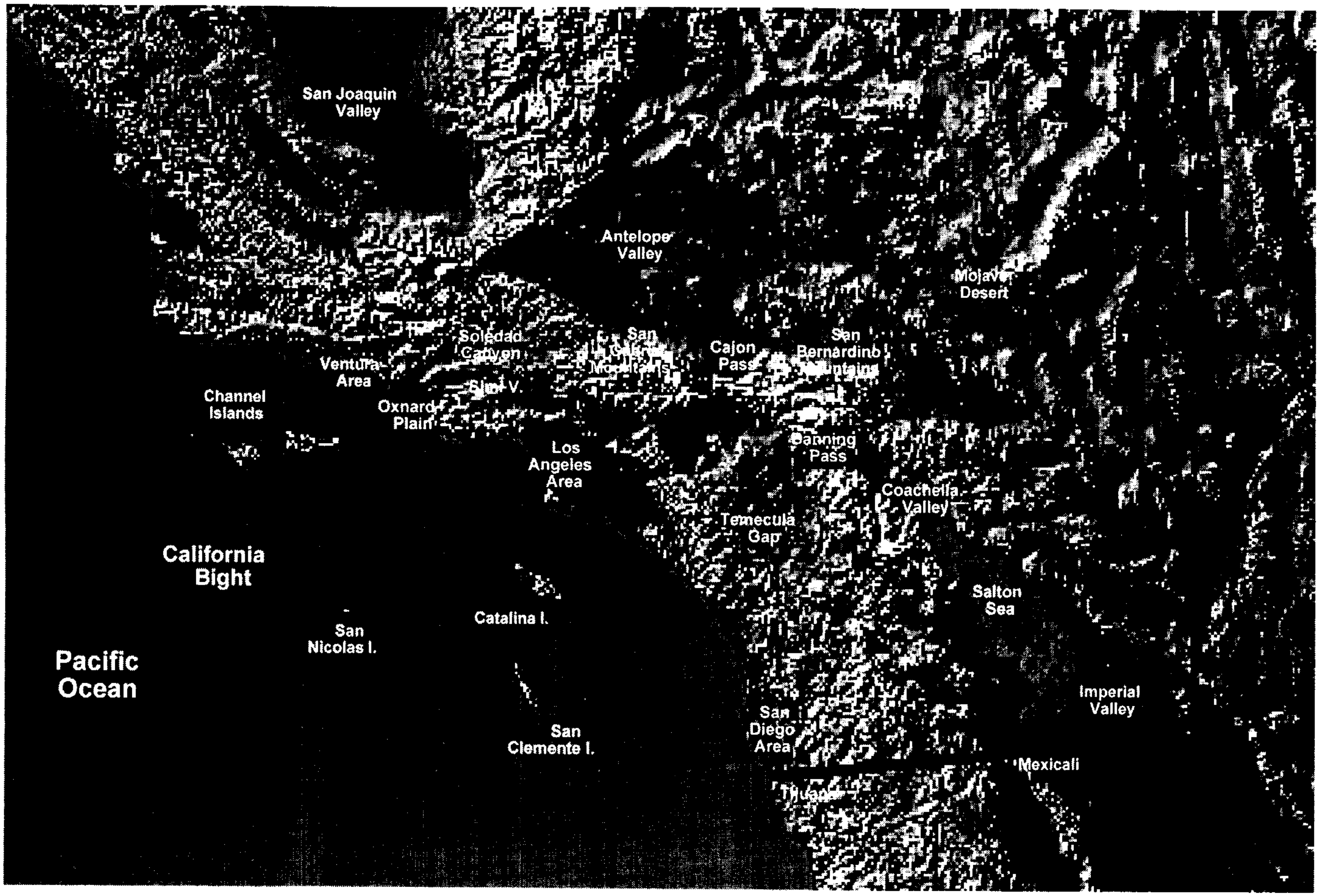

Figure 2-2. Topography of the SCOS97 study area.

Several experiments and data analysis studies examined the relationship of meteorology to air pollutant transport pathways, diffusion, vertical mixing, and chemical transformation in the SoCAB (e.g., Edinger, 1959, 1973; Edinger and Helvey, 1961; Pack and Angell, 1963; Kauper and Hopper, 1965; Schuck *et al.*, 1966; Estoque, 1968; Lea, 1968; Stephens, 1968, 1969; Miller and Ahrens, 1970; Edinger *et al.*, 1972; Rosenthal, 1972; Shettle, 1972; Smith *et al.*, 1972, 1976, 1984; Drivas and Shair, 1974; Angell *et al.*, 1975, 1976; Kauper and Niemann, 1975, 1977; Husar *et al.*, 1977; Keith and Selik, 1977; Blumenthal *et al.*, 1978; McRae *et al.*, 1981; Witz and Moore, 1981; Farber *et al.*, 1982a, 1982b; McElroy *et al.*, 1982; Reible *et al.*, 1982; Sackinger *et al.*, 1982; Schultz and Warner, 1982; Shair *et al.*, 1982; Witz *et al.*, 1982; Smith and Shair, 1983; Cass and Shair, 1984; Smith and Edinger, 1984; Zeldin *et al.*, 1989; Douglas *et al.*, 1991; Bigler-Engler and Brown, 1995;Lea *et al.*, 1995). These experiments and others reveal several general features.

Smith *et al.* (1972), Keith and Selik (1977), and Hayes *et al.* (1984) describe wind flow patterns in the SoCAB. During summer, the sea-land breeze is strong during the day with a weak land-sea breeze at night. Owing to the high summer temperatures and extensive urbanization in the SoCAB, the land surface temperature does not usually fall below the water temperature at night, and nocturnal and morning winds are less vigorous than daytime winds. The land surface cools sufficiently to create surface inversions with depths as shallow as ~50 m. Surface heating usually erodes the surface and marine layers within a few hours after sunrise each day. Summertime flow patterns are from the west and south during the morning, switching to predominantly westerly winds by the afternoon. The land/sea breeze circulation moves air back and forth between the SoCAB and the Pacific Ocean, as well as along the coast to other air basins. Cass and Shair (1984) estimated that up to 50 percent of the sulfate measured at Lennox was due to emissions which had been transported to sea on the previous day. When wind speeds are low, air tends to slosh back and forth within the SoCAB.

In addition to these general features, there are many smaller features that affect the movement of pollutants within the SoCAB. Heating of the San Gabriel and San Bernardino Mountains during the daytime engenders upslope flows that can transport pollutants from the surface into the upper parts of, and sometimes above, the mixed layer. When the slopes cool after sunset, the denser air flows back into the SoCAB with pollutants entrained in it. Convergence zones occur where terrain and pressure gradients direct wind flow in opposite directions, resulting in an upwelling of air. Smith *et al.* (1984) have identified convergence zones at Elsinore (McElroy *et al.*, 1982; Smith and Edinger, 1984), the San Fernando Valley (Edinger and Helvey, 1961), El Mirage, the Coachella Valley, and Ventura. Rosenthal (1972) and Mass and Albright (1989) identified a Catalina Eddy, a counterclockwise mesoscale circulation within the Southern California Bight, as a mechanism for transporting air pollution. This eddy circulation transports pollutants from the SoCAB to Ventura, especially after the SoCAB ozone levels drop due to wind ventilation caused by an approaching low-pressure trough from the northwest. However, any southeast wind in southern California is initially capable of transporting polluted air consisting of ozone precursors and particulate matter from the SoCAB.

General meteorological conditions and trajectories during the 1987 SCAQS episodes have been examined by Douglas *et al.* (1991). Flows during the summertime were westerly, and residence times were often less than 12 hours. The backward trajectories from Claremont and Riverside on August 27 and 28, 1987 show an upper level recirculation in the middle of the SoCAB that probably led to the build-up of ozone and precursors during this episode. Trajectories during SCAQS episodes were consistent with stagnation conditions desired for selecting episodes, and they provide confidence that the SCAQS forecasting methods can be successfully adapted to SCOS97 to evaluate high ozone episodes in the SoCAB. Summer episodes showed west to east transport with potential for pollutant carryover aloft. Forecasting methods for transport from the SoCAB to other air basins, or between other southern California basins, are more problematic and additional work will be needed to improve forecasting procedures.

Green *et al.* (1992a) classified wind field patterns in the SoCAB, San Joaquin Valley, and Mojave Desert during 1984 and 1985 to evaluate visibility reduction in the desert. This analysis evaluated transport between the SoCAB and the Mojave and Arizona deserts. Winds were found to be directly related to the pressure field, which, in summer, resulted from a consistent mesoscale component added to a varying synoptic-scale component. Three main summer patterns were found, all of which had some transport into the SEDAB from the SoCAB. The first, and predominant, pattern indicated typical summer conditions with the wind field driven by the ocean/interior temperature difference and terrain features. The second pattern typically occurred in early summer (May-early June), and had stronger flow into the desert due to synoptic-scale pressure gradients (upper level low pressure over the west coast, surface low over the Intermountain region). This type was also less stable due to cold air aloft. The third pattern showed weaker flow into the desert (and flow from the SEDAB to the SoCAB for a few hours per day) due to higher pressure to the northeast.

The predominant surface wind climatologies for California have been compiled for ARB by Hayes *et al.* (1984) based on 1977-1981 wind data. Figure 2-3 (after Hayes *et al.*) shows seven types of wind flow patterns for the SoCAB and the surrounding air basins. Not shown is an eighth possible condition of essentially calm winds. Table 2-4 gives the frequency of occurrence, expressed as a percentage, of each of these eight wind-pattern types for four times daily during each season. It should be noted that for certain times of day, particularly during the summer, southeast winds may be the predominant wind near and within the inversion (Lea *et al*, 1995; Fisk, 1996a, 1996b).

During summer (June-August) and fall (September-November), the Calm (Type VII), Offshore (Type III), and Downslope/Transitional (Type V) patterns dominate the early morning hours, allowing pollutants to accumulate in SoCAB industrial and business areas. Pollutants then move inland with the Sea Breeze (Type II) in the afternoon hours. However, a period of southeast flow towards Ventura County can occur as the land breeze veers to a daytime sea breeze. While this diurnal sequence is most common during the ozone season, other combinations of wind patterns occur that drive interbasin transport. For example, off-shore surface transport from the SoCAB to San Diego may occur with the Offshore winds (Type III), the Downslope/Transitional winds (Type V), and/or the Weak Santa Ana winds (Type VIa).

2.3 Study Period and Intensive Operational Periods

The SCOS97 field measurement program was conducted during a four-month period from June 16, 1997 to October 15, 1997. This study period corresponds to the majority of elevated ozone levels observed in southern California during previous years. Continuous surface and upper air meteorological and air quality measurements were made hourly throughout this study period. The PAMS monitoring program, which typically operates annually from July 1 to September 30, operated from June 1 to October 31, 1997.

2.3.1 Ozone Periods

Additional measurements were made during intensive operational periods (IOPs) on a forecast basis for two to four consecutive days. Forecasts were prepared each day during the four-month period and IOP measurement groups were on standby. Five categories of meteorological conditions, called scenarios, were defined and are associated with ozone episodes and ozone transport in southern California. Intensive measurements were made during these scenarios. The five scenarios in order of priority as specified by the SCOS97-NARSTO Technical Committee are:

Type 1. *SoCAB Ozone Maximum.* SoCAB pollutants remain trapped within SoCAB. There may be "local" exceedance days for other basins. This condition may be accompanied by a "coast hugger," a near-coast flow of SoCAB pollutants toward the southeast.

Type 2. *Upper-level transport to San Diego Air Basin* Ozone in a layer 300-500 m MSL above the marine layer or above the nocturnal inversion jets southeast toward San Diego. The centerline and width of this pathway are uncertain, and may range from the Interstate 15 route (east) to an off-shore route (west)

Type 3. *Secondary SoCAB Maximum.* An on-shore breeze causes inland transport, with likely transport into the Mojave Desert. This situation may also correspond to local exceedances for Ventura, Santa Barbara, and San Diego Counties.

Type 4. *Coastal Day with Eddy.* This is an extended SoCAB episode that ends with a southeast wind offshore, over the basin, and even sometimes in the desert. It is possibly an extension of Scenario #1 or #2. The ozone peaks are often seen at Newhall or Simi Valley on these days.

Type 5. *Off-shore surface transport direct to the San Diego Air Basin.* This event is characterized by a mild Santa Ana wind condition followed by the on-shore flow. It occurs with greatest frequency later in the ozone season (September-October).

The five meteorological scenarios of interest fall within three overlapping periods which together span the entire ozone season. Types 1, 2, and 3 can occur throughout the summer, but have the highest probability of occurrence in mid-summer. Type 4 typically occurs during the late spring to early summer, while Type 5 occurs from late summer to early fall.

Figure 2-3 South Coast Air Flow Pattern Types

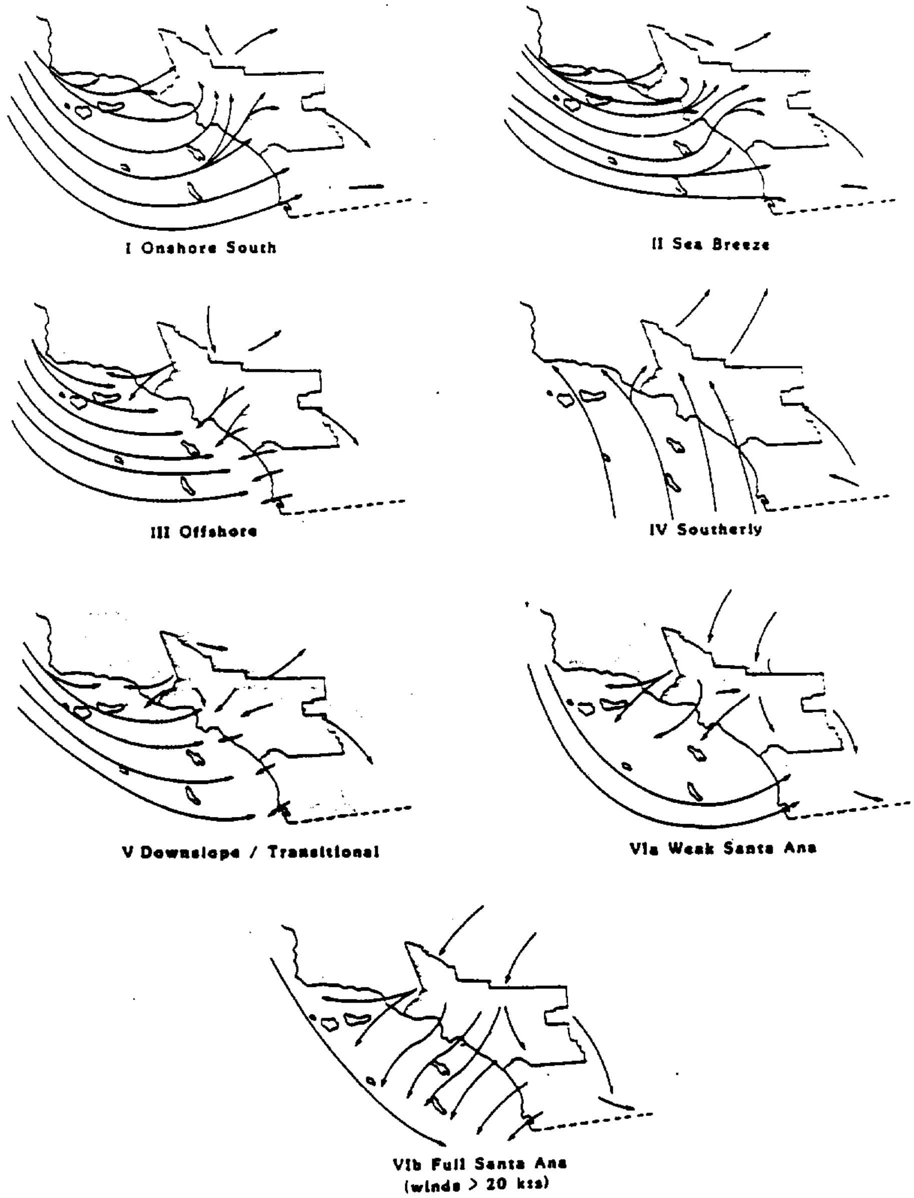

Table 2-4
South Coast Air Basin Airflow Types
Seasonal and Diurnal Percentages of Occurrence (1977-1981 Data)

Types Time - PST	I On-Shore South	II Sea Breeze	III Off-shore	IV Southerly	V Downslope/ Transitional	VIa Weak Santa Ana	VIb Full Santa Ana (>20 kts)	VII Calm
Winter								
4 a.m.	3	3	25	3	17	10	7	29
10 a.m.	10	9	16	15	16	12	7	13
4 p.m.	24	51	4	11	4	4	2	0
10 p.m.	6	7	19	7	20	11	7	23
all times	11	18	16	9	14	9	6	16
Spring								
4 a.m.	10	8	19	6	26	4	3	24
10 a.m.	43	29	3	12	5	2	1	2
4 p.m.	31	61	2	4	1	1	1	*
10 p.m.	23	26	9	4	23	3	1	10
all times	27	31	8	6	14	3	2	9
Summer								
4 a.m.	10	5	4	4	34	1	1	37
10 a.m.	51	41	1	6	1	*	*	0
4 p.m.	26	73	0	1	0	0	0	0
10 p.m.	34	39	2	2	18	1	*	5
all times	30	40	2	3	13	1	*	11
Fall								
4 a.m.	7	10	16	2	26	7	4	25
10 a.m.	33	29	5	6	10	6	4	7
4 p.m.	20	67	4	2	2	1	1	4
10 p.m.	16	19	13	2	27	5	3	15
all times	19	31	10	3	16	5	3	13
Yearly								
4 a.m.	8	7	16	4	26	6	4	29
10 a.m.	34	27	6	10	8	5	3	6
4 p.m.	25	63	3	5	2	2	1	1
10 p.m.	20	23	11	4	22	5	3	14
all times	22	30	9	6	14	4	3	12

* < 0.5 percent

2.3.2 Aerosol Periods

The goals of the SCOS97-NARSTO Aerosol Program and Radiation Study were to develop a three-dimensional picture of the generation and evolution of typical late summer and early fall aerosols in the SoCAB, and to provide observations to support modeling of the emissions, meteorological transport and dispersion, and photochemical reactions forming ozone, PM2.5, and PM10. The experimental design focused on ambient sampling along two trajectories in southern California and a motor vehicle particle experiment to test emissions using California fuels, conducted in a tunnel in northern California:

I. A general urban aerosol generation and evolution "trajectory" began in the emissions-rich central Los Angeles area, going to a mid-trajectory site in the San Gabriel Valley, and ending in Riverside.

II. A nitrate dynamics trajectory was run from Diamond Bar, downwind of the most heavily populated portions of the Los Angeles coastal plain, across the ammonia-rich dairying area in the Chino Basin, and ending in Riverside.

III. A sampling program at the Caldecott Tunnel in northern California to measure fine particle size distributions and chemistry to develop source profiles to discriminate between emissions from light-duty (primarily gasoline-fueled) and heavy-duty (mainly diesel-fueled) vehicles.

The SCOS97-NARSTO Aerosol Program and Radiation Study consisted of six interconnected studies: a Trajectory Study, a Tunnel Study, a Fine Particle Measurement Study, a PM2.5 Federal Reference Method Nitrate Loss Study, a Radiation Study, and an Aerosol Aircraft Study. Study dates were generally from August 16 to September 29, 1997 (see Figure 2.3.2-1), with any differences noted below.

Trajectory Study

The Trajectory Study collected continuous aerosol size distribution and composition data simultaneously at three sites. These data will provide the basis for subsequent work to develop, evaluate, and improve photochemical models to simulate the chemical and physical transformations that occur as particles age and travel in the atmosphere. While many of the measurements were made over the entire 6-week period (August 16 to September 29, 1997) of the study, the full suite of sampling was conducted over five 48-hour intensive operational periods (IOPs) selected on the basis of meteorological and air quality forecasts.

The first set of measurements was made at Los Angeles-North Main, Azusa, and Riverside-Pierce Hall, corresponding to a motor vehicle-dominated west-to-east air trajectory along almost the entire length of the SoCAB. Several novel instruments operated continuously for the two-week duration: ATOFMS single-particle analysis and particle size distribution measurements by optical counters and electrical mobility at all three sites, and continuous aerosol nitrate measurements at Riverside-AgOps. Filter-based sampling was conducted during the IOPs (August 21-22, August 26-27) to calibrate the ATOFMS instruments with atmospheric particles and to give further detail on aerosol size and composition. At all three sites, PM2.5 and PM10 composition were measured with 4- to 7-hour-average filter samples for the entire 48-hour period. Micro-orifice impactor samples were collected over one 4-hour period each day at all three sites to determine particle composition in six size ranges from 0.056 to 1.8 μm.

The second set of measurements (September 4-5, September 28-29, October 31-November 1) were conducted at Diamond Bar, Mira Loma, and Riverside-Pierce Hall to focus on nitrate formation along the trajectory.

Tunnel Study

A successful data analysis and modeling effort using the database collected during the Trajectory Study depends on the acquisition of detailed emission source profiles for gasoline- and diesel-fueled motor vehicles. The Caldecott Tunnel east of Oakland is uniquely configured with a center bore only open to passenger vehicles and side bores where trucks are shunted. Thus, the particulate matter concentrations in the center bore are dominated by light-duty gasoline vehicles, and the aerosol burden in the side bores are primarily due to emissions from heavy-duty diesel trucks. During the period November 17 through 21, four experiments were conducted at Caldecott Tunnel

Fine Particle Study

The EPRI-sponsored Fine Particle Measurement Study was conducted at Riverside-AgOps from August 16 to September 22, 1997. Both continuous and 24-hour-average samplers were deployed for the study, with duplicate side-by-side samplers installed when possible. Daily sample changes were made at 10:00 a.m. Pacific Daylight Time (PDT). The continuous aerosol nitrate monitor was operated at Riverside-AgOps during the first two weeks, after which time it was moved to the Mira Loma site.

Comparison of mass and chemical data from continuous samplers (where loss of labile substances is believed minimal) with data from the more conventional filter-based methods (where losses may occur during or after sampling) will begin to characterize the magnitude of measurement error due to loss of labile substances.

PM2.5 Federal Reference Method Nitrate Loss Study

The PM2.5 FRM Nitrate Loss Study was conducted in conjunction with the Trajectory Study. Two FRM samplers were operated side by side at each of the three Trajectory Study sites for the first four experiments. Daily sample changes were made at 1:00 a.m. PDT.

Radiation Study

To test the study design and instrument operation, intensive measurements were initially made on June 29 to July 5, but data recovery at the Mt. Wilson site was incomplete due to logistical and exposure problems. The study began collecting complete data on August 21 when equipment at a new Mt. Wilson site became fully operational. Intensive monitoring on August 27-28 and September 4-6, 10, and 12 was supported by the highly instrumented Pelican aircraft, described in the following section, which provided vertical profiles of irradiance and aerosol size and concentration. Intensive radiation measurements were also made, but without the support of the Pelican, on August 21-23 and October 30-November 1.

Aerosol Aircraft Study

For aerosol and radiation measurements aloft, the Pelican aircraft was operated by the Center for Interdisciplinary Remotely-Piloted Aircraft Studies (CIRPAS), a consortium of the Office of Naval Research, the Naval Postgraduate School, the California Institute of Technology, and Princeton University. Between August 27 and September 13, CIRPAS obtained measurements of the concentrations and size distributions of particulate matter and its constituent chemical species.

A display of the daily maximum 1-hour PM10 [measured with tapered element oscillating microbalance (TEOM)] and ozone concentrations recorded at Riverside-AgOps during continuous and intensive operational periods for the SCOS97-NARSTO Aerosol Program and Radiation Study is given in Figure 2.3.2-1. PM10 concentrations could be much higher than shown because the TEOM is heated to between 30 and 50 ^{O}C to eliminate humidity effects and a substantial fraction of ambient particles can be semi-volatile material such as aerosol nitrate and some organic compounds. It is interesting to note that two of the highest PM10 periods during the study occurred after hurricanes off the coast of Mexico brought large amounts of moisture to the SoCAB. A likely explanation is that formation of aerosol nitrate from gas-phase ammonia and nitric acid was favored under the high relative humidity conditions.

A statistical summary of the 24-hour-average ozone and PM10, and the average of maximum 1-hour concentrations, between August 15 and September 30 of 1995 to 1997, is presented in Table 2.3.2-1. Ozone and PM10 concentrations were about 20% lower in 1997 than the same time period in 1995. This apparent decline could be due to the introduction of California Phase 2 reformulated gasoline in 1996 or meteorological variability. Increased frequency of positive vorticity advection and mid-atmospheric troughing just west of the Pacific Coast (associated with El Niño activity) seemed to contribute to a deeper marine layer and better mixing over the SoCAB during the summer and early fall of 1997.

Preliminary analysis of the data taken at Riverside-AgOps during August 15 and September 30, 1997 show that the PM10 concentrations exhibited an afternoon peak coincident to the ozone peak. Figure 2.3.2-2 illustrates this point for August 22, 1997 with hourly PM10, ozone, and NO_x concentrations. Both PM10 and NO_x exhibited a pronounced morning peak concurrent with low ozone concentrations. The automated nitrate monitor revealed a double peak in the daily nitrate concentration profiles at Riverside. Nitrate concentrations generally increased in the midmorning hours, decreased around noon, and rose again in the afternoon. The relative magnitude of these two peaks varied from day to day.

Table 2.3.2-1. Ozone and TEOM PM10 concentrations, averaged for the time period from August 15 to September 30 for each year (1995, 1996, and 1997) at Riverside-AgOps.

Year	Ozone (ppb)		TEOM PM10 ($\mu g/m^3$)	
	24-hour average	1-hour daily maximum	24-hour average	1-hour daily maximum
1995	42	118	50	101
1996	40	107	45	85
1997	34	95	38	79

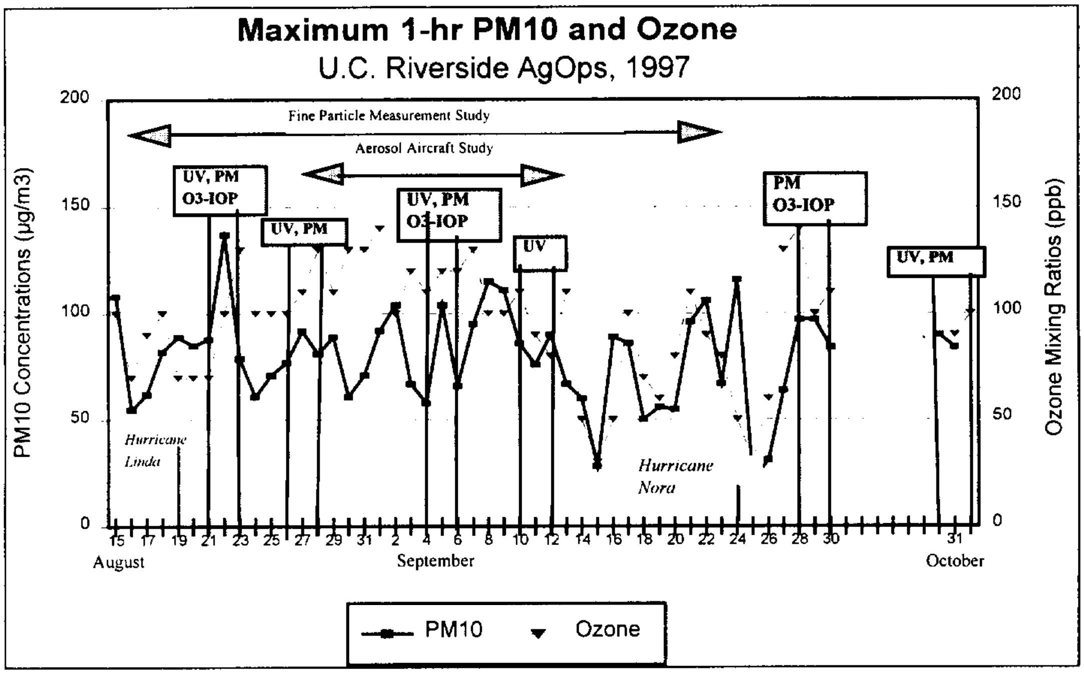

Figure 2.3.2-1. Daily maximum one-hour TEOM PM10 and ozone concentrations during the SCOS97-NARSTO Aerosol Program and Radiation Study with intensive operational periods shown for the Trajectory Study (PM), the Radiation Study (UV), and the Ozone Study (O3-IOP).

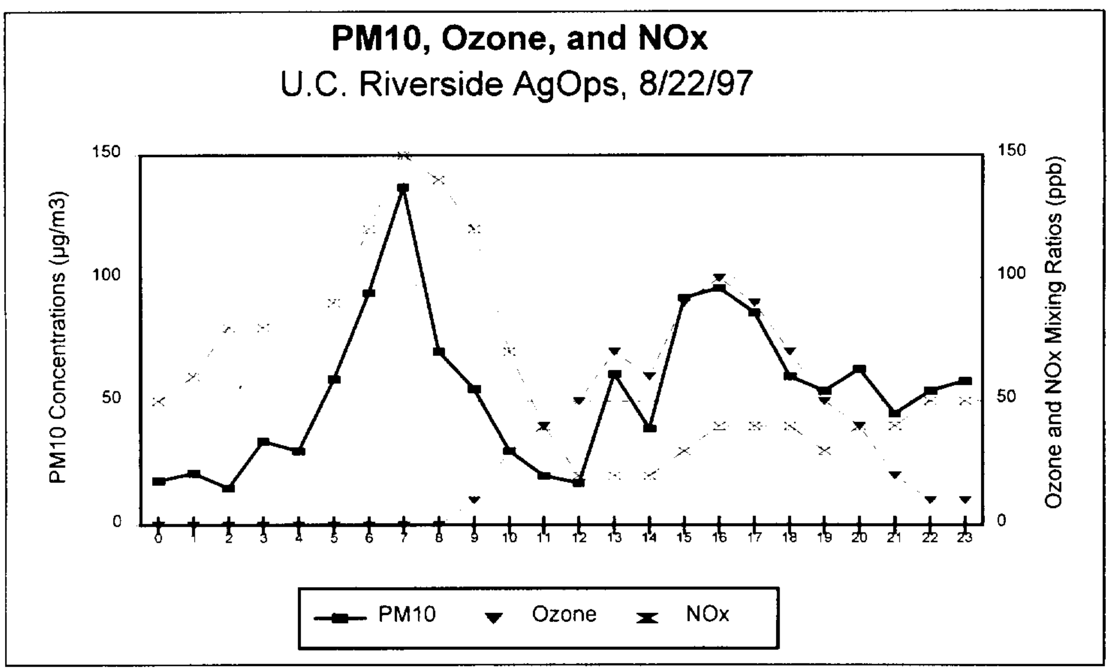

Figure 2.3.2-2. Duirnal profiles of ozone and NO_x mixing ratios at U.C. Riverside-AgOps on August 22, 1997, exhibiting an association with TEOM PM10 concentrations.

2.3.3 Tracer Study Periods

The port of Los Angeles and Long Beach are among the busiest in the world and significantly effect ambient air quality in the South Coast Air Basin. Moving the shipping channel farther off-shore has been suggested as a method to minimize the effects of ship traffic on on-shore air quality. The objective of the tracer study was to evaluate the effects on shipping emissions from moving the current shipping lanes farther from shore.

The tracer experiments were conducted when weak on-shore flows and high ozone levels were expected. These are the conditions where shipping emissions would make their largest contribution to on-shore air quality problems. During the tracer tests three ships released up to five different tracers from locations within the current and proposed shipping lanes. Up to 51 monitoring stations located through out the South Coast Air Basin measured the concentrations of the tracer gases. By comparing the releative concentrations of the five tracers an estimates of shipping emissions effects on on-shore air quality and of moving the shipping lane farther off-shore will be made.

2.4 Forecast and Decision Protocol

To ensure the goals of the SCOS97-NASTO field program were met, it was important that the appropriate air quality episodes were correctly identified. This required that a forecast team be formed to identify and forecast meteorlogical episodes which would lead to the formation of high concentrations of ozone and/or aerosol in the South Coast air basin and subsequent transport to downwind air basins. The forecast team would report their forecast to the field program management committee (FPMC). The FPMC was comprised of representatives from the Research and Technical Support Division of the California Air Resources Board (CARB), U.S. Navy at Pt. Mugu, South Coast Air Quality Management District (SCAQMD), San Diego Air Pollution Control District (SDAPCD), U. S. EPA, and Ventura County Air Pollution Control District (VCAPCD). The FPMC would then decide by consensus whether an IOP would be called and notify the field study participants by email, internet home page, and telephone bill board.

2.4.1 Forecast and Decision Protocol - Ozone Periods

The forecast team was comprised of meteorologists from the California Air Resources Board (CARB), U.S. Navy at Pt. Mugu, South Coast Air Quality Management District (SCAQMD), San Diego Air Pollution Control District (SDAPCD) and Ventura County Air Pollution Control District (VCAPCD). A two-day minimum notification lead prior to an IOP was needed for equipment preparation and to allow participants to make travel arrangements to Southern California. A day-in-advance confirmation of the predicted meteorological profile and expected ozone was required before the IOP was launched. To meet these needs, the forecast was required to provide a detailed prediction of the same-day, day-in-advance and two-day expected ozone and meteorological profile for Southern California. In addition, each forecast included a three-day prediction to indicate the direction of the ozone trend (either up, down, or continuing) to provide the management team with an estimation of the likeliness of an extended IOP.

The FPMC was required to make a Go/No Go decision by 4:00 p.m. PDT daily. To meet the FPMC's needs the forecast needed to be prepared by 3:00 p.m. A 2:30 p.m. PDT daily conference call was scheduled to bring together the forecast team to finalize the forecast. The 2:30 PDT forecast time was selected to provide the individual forecast teams with access to the evolving ozone trend and the latest output from the 0500 PDT (1200 UTC) National Weather Service (NWS) numerical model simulations. The forecast discussion was conducted in three phases: (1) weather discussion and preliminary forecast, (2) group discussion and consensus forecast modification, and (3) extended outlook. Prior to the discussion, a preliminary forecast based on the SCAQMD objective model was faxed to each of the forecast groups along with an initial forecast summary. The forecast team members held discussion until a consensus was reached or a failure to agree was logged. The decision was then finalized and relayed to the FPMC.

The FPMC would then reach a consensus on whether to call an IOP. The IOP decision announcements were as follows:

- **"Possible-Go"** (or "No-Go") would be posted by 4 p.m. for an IOP start 35 hours later.

- **"Definite-Go"** (or "No-Go") would be posted by 11 a.m. for an IOP start the next morning at 0300 (midnight for the SCAQMD) for speciated VOC sampling and 0500 for rawinsondes. Under some, hopefully rare, circumstances the "Definite-Go" decision would be postponed until 4 p.m. that day, in which case the 11 a.m. posting would be for a "Possible-go".

- **After an IOP has started**, the second, third, and fourth days are automatically "Possible-Go". "Definite-Go" or "No-Go" decisions for each successive IOP day would be posted at 11 a.m. the day before, with the possibility that the decision would be postponed to 4 p.m.

- **Once a "No-Go" decision is posted, it will not be changed.** A "Definite-Go" decision would only be changed if the predicted meterological situation totally collapsed. In this case, each measurement group would be notified individually.

2.4.2 Forecast and Decision Protocol - Aerosol Periods

Over the entire 6-weeks period (August 16 to September 29, 1997) the trajectory study, aircraft study, and FRM nitrate loss study relied on forecasts from the SCAQMD for selecting the best two days (PM episode) of the upcoming week for intensive sampling.

In general typical meteorological characteristics of a high PM10 day in the SoCAB include: a well developed upper-level ridge of high pressure, strong elevated subsidence inversions, low level stratus and fog, and a nearly neutral surface and boundary layer wind field. However, increased frequency of positive vorticity advection and mid-atmospheric troughing just west of the Pacific Coast (associated with El Niño activity) seemed to contribute to a deeper marine layer and better mixing over the SoCAB during the summer and early fall of 1997.

Two consecutive days of measurements were made each week, chosen in consultation among Professors Glen Cass and John Seinfeld of Caltech, Joe Cassmassi of SCAQMD, professor Kim Prather of U.C. Riverside, Dr. Susanne Hering of ADI, and Mr. Tony VanCuren of ARB.

"Go" Decision Protocol and Announcements

- Each day, by 3 PM, the group made a "No-Go" or "Probable-Go" decision for aerosol measurements commencing in 34 hours. Once a "No-Go" decision was made, it could not be changed.
- If the following day was a "Probable-Go", the group made a final "No-Go" or "Definite-Go" decision for aerosol measurements by 11 AM.
- Each day, by 3 PM, the ARB posted the decision on the phone machine and with an e-mail message.
- The 2-day IOPs were at least 2 days apart.
- The preference was to have at least one 2-day IOP each week.
- Intensive sampling periods could occur on a weekend, if it was the time period of high PM concentrations.

2.5 Summary of Ozone Intensive Operational Periods

Six Intensive Operational Periods (IOPs) were called during the 1997 Southern California Ozone Study which was conducted in coordination with the North American Research Strategy for Tropospheric Ozone (SCOS97-NARSTO). The first IOP was cut short (lasted only one day) due to the unanticipated high clouds from a hurricane south of the study area. Three other IOPs had partial deployment of resources on the day before or after the IOP to better characterize the full ozone episode. A summary of the IOPs, Table 2.5a, provides information on the dates, day-of-week, type of episode, maximum 1-hour and 8-hour ozone concentrations by sub-areas, aircraft activities, and concurrent aerosol or tracer release activities. The air quality concentrations noted are based on preliminary data and are subject to change. Intensive Operational Days for aerosols occurred on five ozone intensive days during three ozone IOPs. The three offshore tracer releases also occurred during three ozone intensive days. Exceedances of the national ambient air quality standards for ozone occurred during all six episodes.

To provide the context of the IOPs during SCOS97-NARSTO, Table 2.5b and Figures 2.5a-f are included in this summary. The Table and Figure provide the daily maximum 1-hour and 8-hour ozone concentrations observed in each air basin within the SCOS97-NARSTO modeling domain from June 15 through October 16, 1997. These summaries are based on data residing on the U.S. EPA's Aerometric Information and Retrieval System (AIRS) on March 26, 1998. It is noteworthy that the ozone episodes that occurred during the long Independence Day weekend had among the highest, if not the highest, 1-hour and 8-hour ozone concentrations for the study period.

The following subsections briefly describe the meteorological and air quality conditions observed during each of the IOPs. In principle, the following non-routine measurements were made during each day of an IOP:

1) four 3-hour samples each of volatile organic compounds (VOC) and carbonyl compounds (C=O) at 18 sites (two 12-hour samples were taken at the three background/offshore sites)
2) peroxyacetyl nitrate measurements at Simi Valley and Azusa
3) lidar measurements at two sites (ozone and aerosol scatter at El Monte AP on ozone IOPs and several aerosol IOPs; ozone aerosol scatter, water vapor, and temperature near Hesperia between August 23 and September 19)
4) four ozonesonde releases (at 0800, 1400, 2000, and 0200 PDT) each day from 7 sites (Anaheim, California State University at Northridge, Pomona/Upland, Point Mugu, Riverside, University of Southern California, and Valley Center
5) four rawinsonde releases (at 0500, 1100, 1700, and 2300 PDT) each day from 12? sites (Bakersfield, China Lake Naval Air Weapons Center, Edwards AFB, Imperial Beach, Miramar Naval Air Station, North Island Naval Air Station, Pt. Mugu Naval Air Weapons Center, San Nicolas Island, Tustin, Twentynine Palms-Expeditionary Air Field, University of California at Los Angeles, and Vandenberg AFB
6) multiple flights per day by up to six aircraft
   a) Aztec - northern boundary and trans-basin in SoCAB; also back-up for Navajo
   b) Navajo - western boundary and offshore
   c) Partnavia - offshore

d) San Diego Cessna 182 - southern domain

e) UCD Cessna 182 - central SoCAB

f) Pelican - SoCAB aerosol characterization (flights coincided with ozone IOPs only on September 3-6)

Occasions when measurements did not occur as planned during an IOP are noted in discussion.

Table 2.5a List of Ozone Intensive Operational Days During SCOS97-NARSTO

Date[#]	Day	Episode Type*	Max 1-hr/8-hr Ozone Concentrations (pphm)						Number of Flights						Other IOPs[+]
			SC	VC	SD	MD	SB	IC	CP	SDC	SDN	STI	UCD	USN	
Jul 14	Mon	1-,2-,3-	14/10.6	9/ 8.0	10/ 6.9	11/10.3	6/ 5.7	9/ 8.1	0	0	0	1[1]	2	0	
Aug 4	Mon	1-,2-,3-	14/10.5	9/ 7.7	11/ 9.9	12/ 8.1	7/ 6.0	10/ 9.3	0	2	1	2	3	0	
Aug 5	Tue	1-, 2-	19/11.9	9/ 8.1	12/ 8.7	11/10.4	10/ 8.1	10/ 9.3	0	2	2	2	3	2	
Aug 6	Wed	1-, 3, 4,5-	16/12.5	13/11.5	10/ 8.4	13/10.7	9/ 8.2	8/ 8.0	0	2	1	2	3	2	
Aug 7[2]	Thu	1-,3,4-	15/12.2	12/ 8.8	7/ 5.2	14/11.3	10/ 8.7	8/ 7.1	0	0	0	1	0	1	
Aug 22	Fri	1-,3-	13/ 9.0	9/ 7.5	8/ 6.3	10/ 9.0	7/ 5.5	12/10.0	0	2	2	2	3	2	A
Aug 23	Sat	1-,3-,4-,5-	14/10.6	10/ 8.9	10/ 7.0	11/ 9.0	7/ 5.4	8/ 7.1	0	2	2	2	3	0	T
Sep 3[3]	Wed	1-	13/ 9.0	8/ 7.4	9/ 7.3	8/ 6.6	8/ 6.0	6/ 5.2	0	0	0	1[1]	3	0	
Sep 4	Thu	1-,2	16/ 9.9	9/ 7.5	13/ 9.0	7/ 6.3	9/ 7.5	6/ 4.9	1	2	2	2	3	1	A & T
Sep 5	Fri	3-	12/ 9.1	10/ 7.2	8/ 8.8	10/ 6.9	7/ 6.8	8/ 5.8	1	2	2	2	2	2	A
Sep 6	Sat	0	12/ 9.4	9/ 7.1	8/ 5.9	8/ 7.3	6/ 4.7	7/ 5.7	1	2	2	2	2	2	
Sep 27[3]	Sat	1-,2-	14/10.2	9/ 7.5	11/ 9.6	8/ 6.4	8/ 6.8	6/ 5.9	0	1	2	0	2	1	
Sep 28	Sun	1-,2-,4-	17/10.7	12/ 9.7	11/ 9.4	6/ 6.4	11/ 9.3	6/ 5.0	0	2	2	2	2	0	A
Sep 29	Mon	4-	11/ 8.9	11/ 8.6	9/ 6.7	10/ 7.7	11/ 7.6	11/ 7.0	0	2	2	2	2	0	A
Oct 3	Fri	0	9/ 7.5	8/ 6.7	4/ 4.0	6/ 5.3	7/ 6.1	7/ 6.1	0	2	2	2	2	1	
Oct 4	Sat	3-, 4-	13/10.5	9/ 7.4	7/ 6.7	10/ 7.4	7/ 6.9	11/ 7.8	0	2	2	2	2	2	T

1 flew western boundary in afternoon
2 aircraft flights in vicinity of Ventura and Santa Barbara Counties to capture eddy transport
3 partial deployment of resources (including NOAA lidar)
\# dates in bold type denote full Intensive Operational Days; dates in normal type denote partial Intensive Operational Days; "-" indicates concentrations less than the study goals for that type of episode

* **Episode Types:**
- 0 No episode
- 1 South Coast Air Basin ozone maximum
- 2 Upper level transport to San Diego
- 3 Secondary South Coast Air Basin ozone maximum with transport into Mojave Desert
- 4 Eddy transport to Ventura following episode in South Coast Air Basin
- 5 Off-shore surface transport to San Diego

\+ **Other IOPs:** A = aerosol; T = tracer

abbreviations: SC = South Coast Air Basin, VC = Ventura County, SD = San Diego County, MD = Mojave Desert, SB = Santa Barbara County, aircraft: CP = CIRPAS Pelican (central/eastern SoCAB), SDC = San Diego Cessna (San Diego County), SDN = San Diego Navajo (western boundary), STI = STI Aztec (northern boundary & SoCAB transit), UCD = UCD Cessna (central SoCAB), USN = USN Partnavia (offshore)

Table 2.5b Daily Maximum Ozone Concentrations During SCOS97-NARSTO

Daily Maximum 1-hour and 8-hour Ozone Concentrations (ppb)
by Air Basin During SCOS97-NARSTO
(based on AIRS data base as of 3-26-98)
partial and full intensive operational days are indicated with shading

Date	SoCAB		MDAB		SDAB		SCCAB		SSAB		SJVAB (KC)	
1997	1-hr	8-hr	1-hr	8-hr	1-hr	8-hr	1-hr	8-hr	1-hr	8-hr	1-hr	8-hr
615	95	73	73	68	62	59	66	59	95	79	79	72
616	90	79	102	80	72	63	75	68	97	80	118	92
617	120	100	111	91	84	72	88	85	130	109	129	106
618	140	116	123	102	74	61	114	97	120	89	83	67
619	136	103	126	113	86	70	100	86	105	95	101	82
620	110	81	101	89	68	58	101	84	89	79	92	85
621	114	88	105	99	82	67	77	68	80	70	74	68
622	100	82	96	85	74	61	75	66	71	65	69	66
623	95	80	107	92	71	59	75	67	85	76	75	70
624	115	99	131	118	85	66	104	92	130	111	89	80
625	137	114	125	105	72	64	112	95	130	93	104	92
626	150	105	130	112	90	71	117	95	97	77	91	79
627	144	113	127	115	82	73	99	87	100	90	86	76
628	128	106	116	94	88	81	82	75	90	86	79	69
629	84	71	81	69	84	61	86	79	80	75	66	61
630	82	68	86	77	60	50	66	56	80	79	49	46
701	118	96	105	93	94	83	70	67	100	91	84	72
702	170	139	187	133	101	90	96	91	130	109	90	78
703	205	143	177	133	112	95	115	104	160	120	124	107
704	168	138	152	129	136	112	119	112	100	88	131	113
705	151	124	119	95	120	102	128	110	98	81	99	88
706	147	123	142	120	96	84	114	105	87	80	88	73
707	115	100	117	104	78	58	89	80	100	89	105	84
708	107	101	114	103	77	63	92	86	102	83	110	95
709	124	107	124	105	87	68	104	93	104	93	114	94
710	121	99	120	103	61	56	91	78	90	90	71	62
711	89	71	80	74	69	53	67	59	80	78	77	68
712	96	85	90	82	69	58	80	73	90	84	79	72
713	130	113	115	103	73	64	94	83	108	81	103	91
714	110	90	112	103	77	67	85	75	120	100	114	98
715	95	73	93	85	98	78	73	67	110	88	107	90
716	139	112	136	109	99	83	103	84	131	101	114	90
717	119	99	108	93	88	75	70	65	111	100	83	66
718	109	91	122	97	83	57	86	74	84	73	64	60
719	107	102	111	95	61	54	85	72	91	80	103	88
720	141	125	128	108	73	61	88	80	114	58	107	94
721	106	84	88	83	58	56	104	78	68	84	123	100

Date	SoCAB		MDAB		SDAB		SCCAB		SSAB		SJVAB (KC)	
1997	1-hr	8-hr	1-hr	8-hr	1-hr	8-hr	1-hr	8-hr	1-hr	8-hr	1-hr	8-hr
722	77	55	63	57	67	56	49	42	80	65	74	62
723	118	92	102	72	106	84	99	89	70	68	85	75
724	101	83	89	79	79	66	94	78	84	69	90	82
725	121	88	96	76	88	71	90	74	98	87	111	92
726	132	120	111	101	77	65	77	65	95	76	90	81
727	139	125	97	78	75	62	84	75	111	84	104	87
728	104	97	107	83	63	54	77	65	105	80	105	92
729	105	94	110	89	60	51	73	67	109	86	109	96
730	122	102	119	102	90	72	89	74	87	73	96	87
731	125	100	120	100	86	68	94	88	100	93	103	85
801	123	91	101	77	120	82	90	75	109	85	101	87
802	159	96	113	70	115	81	109	87	143	94	101	84
803	135	112	92	97	117	82	102	85	80	75	118	91
804	**132**	**104**	**124**	**81**	**93**	**72**	**94**	**77**	**114**	**93**	**122**	**93**
805	**187**	**118**	**106**	**104**	**122**	**87**	**100**	**81**	**100**	**93**	**126**	**98**
806	**154**	**118**	**131**	**107**	**103**	**84**	**134**	**115**	**80**	**80**	**141**	**119**
807	**150**	**114**	**141**	**113**	**69**	**52**	**116**	**88**	**87**	**74**	**146**	**118**
808	136	121	128	105	81	61	89	74	91	74	130	105
809	105	94	98	84	65	46	78	61	70	70	100	83
810	84	73	77	67	47	40	51	43	80	73	77	64
811	92	79	85	74	54	45	60	52	92	75	81	71
812	112	99	92	86	69	60	89	66	100	81	120	95
813	129	102	129	97	79	64	85	76	90	81	112	97
814	138	118	102	103	80	65	95	76	116	99	118	96
815	141	119	135	104	73	54	84	67	102	95	125	100
816	109	94	94	79	65	53	63	54	90	80	97	82
817	102	80	94	77	76	61	76	62	70	70	84	75
818	101	80	96	76	77	60	91	73	90	81	102	87
819	75	56	87	75	87	57	66	52	80	80	86	67
820	77	60	79	67	49	38	55	44	80	74	80	73
821	112	72	98	81	63	46	57	48	80	79	100	81
822	**133**	**90**	**103**	**90**	**79**	**63**	**86**	**75**	**124**	**100**	**119**	**95**
823	**139**	**105**	**114**	**90**	**96**	**70**	**102**	**89**	**83**	**73**	**102**	**78**
824	123	101	103	77	76	63	100	77	100	86	83	64
825	103	89	96	81	66	57	79	66	90	76	97	81
826	112	99	93	80	76	65	90	77	100	77	93	79
827	116	96	125	94	103	81	87	83	96	66	89	71
828	132	104	123	90	85	64	92	81	67	62	83	71
829	110	82	87	78	82	62	108	93	85	64	83	70
830	137	100	104	75	89	68	113	100	86	66	104	90
831	153	124	91	83	87	72	116	100	65	60	99	80
901	149	115	124	87	94	69	104	92	69	54	114	92

Date	SoCAB		MDAB		SDAB		SCCAB		SSAB		SJVAB (KC)	
1997	1-hr	8-hr	1-hr	8-hr	1-hr	8-hr	1-hr	8-hr	1-hr	8-hr	1-hr	8-hr
902	97	69	82	62	76	53	112	93	54	49	74	62
903	125	90	82	66	83	73	80	74	60	52	134	106
904	157	99	73	63	94	77	86	75	60	52	110	90
905	113	91	97	69	80	71	95	72	81	58	102	80
906	118	92	82	64	76	59	88	71	67	57	93	73
907	131	96	71	64	75	62	90	68	88	65	90	77
908	100	75	82	73	84	70	80	72	70	56	105	86
909	105	79	111	81	95	65	97	80	58	52	110	87
910	113	83	94	81	73	59	78	68	90	73	88	73
911	96	69	80	67	59	50	96	70	62	54	64	56
912	83	65	95	82	72	59	92	74	69	59	99	82
913	104	77	90	72	90	73	80	73	70	59	92	82
914	107	84	72	60	111	89	96	86	47	38	84	66
915	74	54	54	51	62	43	88	73	74	37	63	50
916	63	49	62	55	68	52	74	63	46	37	60	55
917	92	69	89	69	101	71	74	65	90	63	87	74
918	76	53	76	70	80	56	88	73	61	45	95	70
919	54	43	60	56	77	50	54	51	54	42	61	55
920	88	68	70	61	62	46	77	66	59	48	85	72
921	104	76	67	61	78	65	87	72	92	65	80	75
922	94	74	62	57	91	76	101	88	70	60	107	91
923	113	88	59	55	93	71	137	108	156	92	98	89
924	61	56	56	54	81	72	89	80	57	46	70	56
925	36	34	41	41	52	31	67	65	50	39	46	43
926	51	44	79	72	53	48	78	67	69	60	73	65
927	138	92	77	63	88	75	86	75	60	59	78	65
928	171	107	58	54	105	84	118	97	63	58	109	90
929	112	87	97	77	86	67	114	86	110	70	84	73
930	107	84	81	76	82	66	96	77	78	65	94	78
1001	129	103	120	91	70	58	106	89	110	82	102	90
1002	68	60	59	51	47	45	77	63	100	65	46	35
1003	92	75	60	53	44	40	80	67	70	61	65	59
1004	123	95	102	74	71	67	85	74	110	78	94	83
1005	119	105	124	114	95	73	81	69	120	88	90	79
1006	93	86	85	70	71	68	71	54	65	64	60	50
1007	46	46	52	48	50	48	48	47	50	45	40	36
1008	59	53	60	55	65	53	62	60	61	55	53	48
1009	82	65	72	64	77	67	70	62	68	61	65	60
1010	60	41	58	51	59	47	49	46	100	63	44	41
1011	53	39	48	45	49	46	47	45	50	50	38	33
1012	52	49	48	46	59	52	54	50	50	42	46	41
1013	51	49	51	48	56	46	62	58	50	45	55	45

Date	SoCAB		MDAB		SDAB		SCCAB		SSAB		SJVAB (KC)	
1997	1-hr	8-hr	1-hr	8-hr	1-hr	8-hr	1-hr	8-hr	1-hr	8-hr	1-hr	8-hr
1014	60	47	50	46	56	44	74	63	50	43	55	47
1015	53	43	49	46	71	54	65	58	51	43	72	58
1016	58	50	57	49	63	45	72	63	90	44	76	57

SoCAB = South Coast Air Basin; **MDAB** = Mojave Desert Air Basin; **SDAB** = San Diego Air Basin; **SCCAB** = South Central Coast Air Basin; **SSAB** = Salton Sea Air Basin; **SJVAB (KC)** = Kern County portion of San Joaquin Valley Air Basin

2.5.1 Synopsis of the July 14, 1997 Intensive Operational Period

The first IOP of the SCOS97-NARSTO occurred on Monday, July 14. When the forecast team decided that conditions conducive to the formation of high ozone concentrations on July 15 were not developing as anticipated, the IOP was terminated. Although the IOP was not of sufficient duration for modeling purposes, this IOP served as a valuable "shakedown" exercise for identifying and correcting potential problems before additional IOPs were called.

The preliminary peak 1-hour ozone concentration during this IOP was 14 pphm (the peak on July 15 was 12 pphm). Except for the high ozone concentrations observed during the July 2-6 Independence Day weekend (when a "Stand down" was in effect due to large forest fires in the San Gabriel Mountains and atypical traffic patterns expected during the long holiday weekend), the peak ozone concentration observed during the IOP was the highest until then during the month of July. Maximum 8-hour concentrations were relatively low although the national standard was exceeded in the South Coast, Mojave Desert, and Salton Sea Air Basins. This one-day IOP captured three weak episode types of interest to the study sponsors but resources were held in reserve in anticipation of future episodes with greater potential for high ozone concentrations.

Day 1

Although a high atmospheric pressure system was building in the "Four Corners" region on Monday, July 14, ozone concentrations did not rise as much as forecast due to the influence of high clouds from hurricanes off Baja California and a weak low pressure system off the central coast of California. Only the STI and UCD aircraft flew on this day. The STI Aztec flew the western boundary and offshore route only during the afternoon due to extensive fog during the morning. The influence of the cloud cover and offshore low pressure system further limited ozone production to a peak concentration of 12 pphm on July 15.

2.5.2 Synopsis of the August 4 - 7, 1997 Intensive Operational Period

The first full IOP of the SCOS97-NARSTO occurred from Monday, August 4 into Thursday, August 7. The preliminary peak 1-hour ozone concentration during this IOP was 19 pphm at Riverside. That ozone concentration is the second highest observed during SCOS97-NARSTO (the highest concentration occurred in conjunction with the Independence Day weekend). In addition, this three-day plus episode captured weak versions of all five episode types of special interest to the study planners. High surface temperatures actually may have reduced the peak concentrations by creating a much larger vertical mixing volume than otherwise would have occurred. Although the region of extremely high ozone concentrations was somewhat limited on the peak (second) day of the episode, several sites and areas exceeded the national ambient air quality standard (NAAQS) on the third day of the episode. Despite extremely hot surface temperatures, air conditioning failures, and power outages, the data recovery during this first multi-day IOP of SCOS97-NARSTO appears to have been quite high. Data losses occurred at a couple of radar wind profiler sites and on the morning flight of the western boundary aircraft. Most other data losses were of a short-term nature.

Day 1

On Monday, August 4, a high atmospheric pressure system was building in the "Four Corners" region. On this "ramp-up" day for photochemical modeling, ozone concentrations were highest in the eastern portion of the SoCAB, peaking at 14 pphm at Rim of the World High School and also exceeding the NAAQS at the University of California in Riverside and Banning Airport. Only Black Mountain in San Diego exceeded the California ambient air quality standard (CAAQS). The ozone lidar staff reported two layers of high ozone concentrations (at approximately 1.25 and 2.5 km); the lower layer disappeared with the hot surface temperatures breaking that inversion. Aircraft pilots reported preliminary ozone concentrations of 13 pphm in the vicinity of Temecula. Data were lost from the morning flight of the San Diego Navajo. The USN Partnavia was unavailable on this day.

Day 2

On Tuesday, August 5, 500 mb pressure heights were above 5900 meters and 850 mb temperatures were above 30 degrees C. Very hot surface temperatures were also expected and the concern was whether the temperature inversion would break before high ozone levels occurred. Peak ozone concentrations increased markedly from the previous day in the eastern SoCAB and at Otay Mesa in southern San Diego County. Peak concentrations were 19 pphm at Riverside-Rubidoux and 17 pphm at UC Riverside and Redlands. A limited number of other sites exceeded the NAAQS but with a maximum of 15 pphm. The NAAQS was not exceeded in the surrounding air basins but the CAAQS was exceeded at several sites in San Diego County (Otay Mesa being the highest at 12 pphm) and at one site in Santa Barbara. Aircraft pilots reported preliminary ozone concentrations of 18 pphm near Temecula and San Clemente Island during the morning and 19 pphm in the vicinity of Riverside during the afternoon.

Day 3

On Wednesday, August 6, widespread high ozone concentrations were forecast with a Type 1 episode giving way to episode types 3 and 4. The peak ozone concentration occurred at Rim of the World High School (16 pphm) and 15 pphm concentrations were observed at Redlands and Crestline. Several sites exceeded the NAAQS including Simi Valley in Ventura County and Hesperia in the Mojave Desert. With a coastal eddy developing, concentrations near the coast declined. However, the eddy also advected high ozone concentrations from the SoCAB into Ventura County with exceedances of the NAAQS being observed at Simi Valley and at Laguna Peak and Calabasas during the evening. With stronger on-shore flow, Hesperia, north of Cajon Pass in the Mojave Desert, also exceeded the NAAQS. The San Diego Navajo was only able to fly the western boundary/offshore route during the morning as military operations offshore and mechanical difficulties forced it to abort its afternoon flight.

Day 4

On Thursday, August 7, the coastal eddy thickened the marine layer and pushed the high ozone concentrations in the SoCAB further inland than on the previous day. The highest concentrations were 15 pphm at Lake Elsinore, 14 pphm at Hesperia, Rim of the World High School, Banning Airport, and Phelan. Because of the coastal eddy and the potential for unhealthful ozone concentrations in Ventura County, the U.S. Navy and STI aircraft were authorized to fly over Ventura County and offshore to characterize the distribution of ozone concentrations during the eddy. The departure of the aircraft was delayed by fog and significant amounts of ozone aloft were not encountered by the aircraft. A peak surface ozone concentration of 12 pphm was observed at Simi Valley.

2.5.3 Synopsis of the August 22 - 23, 1997 Intensive Operational Period

The second full IOP of SCOS97-NARSTO occurred on Friday and Saturday, August 22 and 23. The peak 1-hour ozone concentration during this IOP was 14 pphm at Riverside; the peak 8-hour concentration was 10.5 pphm at Redlands. This IOP captured several weak episodes of types 1, 3, 4, and 5. Although the potential for high ozone concentrations was limited, interest existed for capturing a weekend episode with moderate concentrations. However, cloud cover and moisture once again suppressed the peak ozone concentrations. Concentrations were slightly higher on Saturday but with lower ozone levels forecast for Sunday, the IOP was terminated.

Day 1

On Friday, August 22, ozone concentrations were highest in the sunnier northwest portion of the study area: 13 pphm in the San Fernando Valley. Interestingly, ozone concentrations at a site in Imperial County reached 12 pphm and the 8-hour average of 10.0 pphm was the highest in the study area on this day. The NAAQS was exceeded only in the South Coast Air Basin. Aircraft pilots reported ozone concentrations of 7-8 pphm aloft near San Nicolas Island and 15-17 pphm aloft over the central SoCAB. An aerosol IOP also occurred on this day.

Day 2

On Saturday, August 23, peak ozone concentrations increased modestly from the previous day in the coastal air basins. The peak concentrations was 14 pphm at Riverside-Rubidoux. The NAAQS was not exceeded in the surrounding air basins but the CAAQS was exceeded in the South Central Coast, San Diego, and Mojave Desert Air Basins. An offshore tracer release occurred on this day. The USN Partnavia was not available for operations on the second day of the IOP.

2.5.4 Synopsis of the September 3 - 6, 1997 Intensive Operational Period

Both the peak 1-hour and 8-hour ozone concentrations (16 and 9.9 pphm, respectively) during this IOP occurred on September 4 at Mt. Baldy Village. The 16 pphm ozone concentration represents the fourth highest episode observed during SCOS97-NARSTO (the July 2-4, August 5, and September 28 episodes were higher). This three-day plus episode captured the best Type 2 episode event during SCOS97-NARSTO and weak Type 1 and 3 episodes. The NAAQS was only exceeded on September 4 in the SoCAB and SDAB. This IOP also featured two intensive aerosol days and an offshore tracer release.

Day 1

On Wednesday, September 3, a partial IOP was initiated with the NOAA lidar, UCD Cessna, and STI Aztec operating. The Aztec flew the western boundary route during the afternoon while the Cessna made three flights. On this "ramp-up" day for photochemical modeling, ozone concentrations were below the CAAQS in all areas except the SoCAB. The peak 1-hour/8-hour concentrations were 13/9.0 pphm at Mt. Baldy Village in the San Gabriel Mountains.

Day 2

On Thursday, September 4, the CAAQS and the 8-hour NAAQS were only exceeded in the South Coast and San Diego Air Basins. The 1-hour and 8-hour peaks in the SoCAB on this day were also the peaks for the IOP. An aerosol IOP and a offshore tracer release were conducted on this day.

Day 3

On Friday, September 5, no areas exceeded the 1-hour NAAQS and only the SoCAB and SDAB exceeded the 8-hour NAAQS. The CAAQS was only exceeded in the South Coast, San Diego, and Mojave Desert Air Basins on this day. An aerosol IOP also occurred on this day.

Day 4

On Saturday, September 6, the only area to exceed the CAAQS or the 8-hour NAAQS was the SoCAB. Effectively, the last day of the IOP was an Episode Type 0.

2.5.5 Synopsis of the September 27 - 29, 1997 Intensive Operational Period

Both the peak 1-hour and 8-hour ozone concentrations (17 and 10.7 pphm, respectively) during this IOP occurred on September 28 at Upland. The 17 pphm ozone concentration represents the third highest episode observed during SCOS97-NARSTO (the July 2-4 and August 5 episodes were higher). The 1-hour NAAQS was exceeded only on September 27 and 28 in the SoCAB but the CAAQS was exceeded in all areas and the 8-hour NAAQS was exceeded in all areas except the Mojave Desert Air Basin and Imperial County. This IOP also featured intensive aerosol days on the 28^{th} and 29^{th}.

Day 1

On Saturday, September 27, a partial IOP was initiated with the NOAA lidar, UCD Cessna, US Navy Partnavia, and both San Diego aircraft operating. On this potential "ramp-up" day for photochemical modeling, ozone concentrations were above the NAAQS only in the SoCAB and above the CAAQS in the SDAB. The SoCAB and SDAB were also the only air basins where the 8-hour NAAQS was exceeded.

Day 2

The peak 1-hour and 8-hour ozone concentrations during this IOP occurred on Sunday, September 28, 17 and 10.7 pphm, respectively in the SoCAB. The CAAQS and the 8-hour NAAQS were also exceeded in San Diego, Ventura, and Santa Barbara Counties. An aerosol IOP occurred on this day

Day 3

On Monday, September 29, no areas exceeded the 1-hour NAAQS and only the SDAB did not exceeded the CAAQS. The 8-hour NAAQS was only exceeded in the SoCAB and Ventura County on this day. An aerosol IOP also occurred on this day.

2.5.6 Synopsis of the October 3 - 4, 1997 Intensive Operational Period

The last IOP of the SCOS97-NARSTO occurred Friday and Saturday, October 3 and 4. The peak 1-hour ozone concentration during this IOP was only 13 pphm at Rim of the World High School; the peak 8-hour concentration was a relatively high 10.5 pphm, also at Rim of the World High School. The CAAQS was also exceeded in the MDAB and Imperial County. The MDAB was the only area besides the SoCAB to exceed the 8-hour NAAQS. A tracer material was released offshore in the shipping lanes on Saturday, October 4. Both 1-hour and 8-hour ozone concentrations increased significantly in almost all areas from October 3rd to the 4th

2.6 Recommendations of Which IOPs to Model

2.6.1 Recommendations of Which Ozone IOPs to Model

Although ozone concentrations were less than hoped for or even expected during the SCOS97-NARSTO due to the persistent passage of low pressure systems associated with the well-publicized El Niño, the episodes with the highest possible 1-hour concentrations were captured. Valuable insights and information will be gleaned from modeling applications. Four of the six IOPs have reasonable justifications for being modeled. Listed below, in order of priority, are the episodes recommended for potential modeling; pertinent information is also included.

A) August 4 - 7
   1) peak ozone concentration during IOPs (19 pphm)
   2) several episode types occurred
   3) exceedances of CAAQS in all six areas; exceedances of NAAQS in three areas
B) September 3 - 6
   1) concurrent with aerosol IOP and tracer release
   2) concentrations relatively low although SoCAB peak is 16 pphm
C) September 27 - 29
   1) IOP with second highest ozone concentration (17 pphm)
   2) concurrent with aerosol IOP
D) October 3 - 4
   1) low ozone concentrations but relatively large increase from one day to the next in most areas
   2) tracer release occurred on second day

2.6.2 Recommendations of Which Aerosol IOPs to Model

Between August 27 and September 13, Caltech and CIRPAS obtained aircraft measurements of the concentrations and size distributions of particulate matter and its constituent chemical species. The information obtained from aircraft observations of the vertical distribution of gas- and aerosol-phase chemical species will further improve the understanding of the dynamics of particulate air pollution in the SoCAB. It will also be used for testing, diagnosis, and improvement of mathematical models used in assessing the impacts of proposed emission control strategies.

The following is a list of the dates from the SCOS97 aerosol monitoring program, recommended for potential aerosol modeling in the SoCAB. These dates are recommended because the most extensive aerometric data sets are available from advanced continuous (such as ATOFMS single-particle analysis and particle size distribution measurements by optical counters and electrical mobility) and filter-based aerosol measurement equipment at surface sites, an array of solar radiometers, and an aircraft instrumented with advanced aerosol analyzers.

August 26 - August 28

- Aircraft sampling supported the three-dimensional evolution of aerosol size and concentration along the same west-to-east path as the first set of Trajectory Study experiments.

September 4 - 6

- Aircraft sampling supported the "nitrate trajectory" sampling with measurements both along the transport path and over a wider area to help characterize the spatial extent of phenomena observed along the trajectory.

September 9 - 13

- Aircraft sampling provided vertical profiles of irradiance and aerosol size and concentration for the Intensive radiation measurements.

September 27 - September 28

- The nitrate peak was about 40 μg/m3, concurrent with ozone IOP (IOP with second highest ozone concentration of 17 pphm in SoCAB).

3.0 SCOS97-NARSTO MEASUREMENTS

The synopsis of measurements has already provided a general overview of these measurements; this section provides a more detailed description designed to focus data analysts and modelers search for data of particular interest to their question. Important features of the measurement program are the Routine Network, existing meteorological resources and supplemental measurements.

3.1 Site Descriptions

In southern California, the Routine Network forms the matrix of surface data collection for air quality and for meteorological parameters. In this domain, there are also permanent existing surface meteorological monitoring stations that do not collect air quality data, do not report their meteorological data to AIRS, and are not part of the Routine Network. The SCOS97-NARSTO primarily relied on, scrutinized QA at, and in essence, superimposed the supplemental ozone, NO_Y, and aerosol networks on the matrix of the Routine Network. Each SCOS97-NARSTO network also added new stations. As defined here, supplemental stations, temporary or semi-permanent, are those whose data are not reported to AIRS. A more detailed description of the existing Routine Network and existing surface meteorological monitoring sites is provided in section 3.2 of this volume.

The supplemental ozone network included the AeroVironment stations – Calabasas, Cajon Pass West, Santa Catalina Island Airport, Santa Catalina Island Isthmus, and Palos Verdes; the ARB station - Mount Baldy Village; the Children's Health Study stations – Lompoc Cabrillo High School, Lake Arrowhead, Jurupa Valley High School [Mira Loma], Gladstone Elementary School [San Dimas], and UC Riverside Agricultural Experimental Station; the CE-CERT stations – Mount Wilson, Tehachapi Pass, San Nicolas, Atlantic Richfield Oil Company [ARCO Tower], Diamond Bar [South Coast AQMD], and Union Pacific Railroad [Chino Mira Loma]; the South Coast AQMD station– Temecula; the San Diego CAPCD stations – Black Mountain, Red Mountain, San Marcos Peak, Valley Center, Warner Springs, Camp Pendelton, Soledad Mountain, and San Clemente Island; Mojave Desert AQMD station – Cajon Pass East; Santa Barbara CAPCD station – Santa Rosa Island; the Portland State University station – UC Riverside CE-CERT Facility; and the U.S. Navy stations – Point Mugu and Laguna Peak supplemental sites. It is important to note that many of these sites were in the past part of the Routine Network and future monitoring programs may be able to take advantage of the SCOS97-NARSTO experience of operating and managing these sites. Certain of these, such as the Children's Health Study sites, continue to operate routinely. Each subset of the supplemental ozone sites will be described in section of 3.3 of this volume. Table 1 provides a list of supplemental ozone sites. The Santa Barbara CPACD operated the Santa Rosa Island site to provide data during SCOS97-NARSTO and has submitted these data to AIRS. The ARB Mount Baldy Village site also reported data to AIRS.

The supplemental NO_Y network included the AeroVironment stations – Calabasas, and Cajon Pass West; the CE-CERT stations - – San Nicolas Island, Diamond Bar [South

Coast AQMD], Union Pacific Railroad [Chino Mira Loma],Azusa, Banning, Los Angeles North Main, Simi Valley, and Soledad Mountain; the Mojave Desert AQMD stations – 29 Palms, and Barstow; and the San Diego CAPCD station – Alpine. Of these, Azusa, Banning, Los Angeles North Main, Simi Valley, 29 Palms, Barstow, and Alpine report some of their data to AIRS. The NO_Y network will be described more fully in section 3.3 of this volume. Table 2 has a list of supplemental NO_Y sites.

The ten station supplemental aerosol network included the CE-CERT stations – Mount Wilson, Azusa, Azusa North Todd, Diamond Bar, Los Angeles North Main, Union Pacific Railroad [Chino Mira Loma],
and UC Riverside CE-CERT Facility; the Children's Health Study station - Jurupa Valley High School [Mira Loma]; and the UC Riverside station – Pierce Hall. Of these, Azusa and Los Angeles North Main report some of their data to AIRS. Dr. Prather [UC Riverside], Dr. Cass [Cal Tech], Dr. Hering [Aerosol Dynamics], and other aerosol groups from the Harvard School of Public Health and the Brigham Young University operated instruments at the aerosol network sites. The aerosol network will be further described in section 3.6 of this volume. The radiation network consisted of two stations – the Mount Wilson and the UC Riverside CE-CERT facility. This network and the routine radiation network are further described in section 3.6 of this volume. Table 3 has details of aerosol and radiation sites. Please note that site identification for UC Riverside Pierce Hall notes two sites, one for Professor Prather's Lab and the other for the roof of the building; both these sites were noted as the Pierce Hall in the aerosol planning documents [RIPH]. The site identification for CE-CERT facility [RICE] has also been changed to RIRD because it contradicted an earlier site identification designation within the SCOS97-NARSTO Atlas.

In the past few years, through the Photochemical Assessment Monitoring Stations (PAMS) program, and under the direction of the U.S. EPA, hydrocarbon and carbonyl speciation has been added to measurements at the Routine Network in southern California. The SCOS97-NARSTO VOC network expanded the frequency of PAMS monitoring at the Routine Network sites, added new sites, and instituted a rigorous QA program. The 23 site VOC network included the DRI stations – Mexicali [Technical University], Tijuana [Rosarito Beach], Point Conception, San Nicolas Island, Anaheim, Burbank, Santa Catalina Island Isthmus; the U.S. Marines stations –29 Palms; the Portland State University station – UC Riverside CE-CERT Facility; the South Coast AQMD stations – Azusa, Burbank, Hawthorne, Pico Rivera; the San Diego CAPCD – Kearny Mesa [Overland], Soledad Mountain, Alpine; the UC Riverside biogenic hydrocarbon stations – Azusa, Banning, Pine Mountain, Ojai Forest, and Mount Baldy Village; and the U.S. EPA stations at Azusa. Mexicali [Technical University], Tijuana [Rosarito Beach], Point Conception, San Nicolas Island, Santa Catalina Island Isthmus Airport, Soledad Mountain, Pine Mountain, Ojai Forest, 29 Palms, and Mount Baldy stations were added to the PAMS network. Some measurement groups were collocated because DRI needed to continue the reformulated gasoline studies in the SoCAB at the same sites for 1995-97 and new automated continuous sampling at Burbank required rigorous QA through measurement intercomparison. To investigate air pollution transport from SoCAB to the Mojave Desert Air Basin, DRI also operated a halocarbon network at Barstow and Lancaster. Hydrocarbon and carbonyl samples were collected onboard four airplane platforms – San Diego Navajo and Cessna 182, UC Davis Cessna 182, and STI Aztec. Samples were delivered to the El Monte and the Camarillo airports, and to the Montgomery Field and shipped to DRI or to Biosphere Research Corporation [CE-CERT subcontractor] for speciation and analysis. More thorough description of the VOC network is provided in section 3.3 of this volume. A VOC network site list is provided in Table 4. Please note that due to wildfires, the Pine Mountain station had to be moved.

In the past few years and through the PAMS program, EPA has also added meteorological resources aloft, specifically radar wind profilers and radio acoustic sounding systems, to the Routine Network in southern California. These include the South Coast AQMD stations – Los Angeles and Ontario airports; the Ventura CAPCD station – Simi Valley; the San Diego CAPCD stations – Point Loma and Valley Center. To these, ARB added two units early on the SCOS97-NARSTO planning process at the El Monte Airport and the Norton Air Force Base. Then, the TC significantly improved these resources by adding the NOAA [William Neff] stations – Alpine Meteorological, Goleta, Los Alamitos, Port Hueneme, Carlsbad, Palmdale, San Clemente Island Meteorological, Santa Catalina Island Meteorological, Tustin, University of Southern California Meteorological, and the Van Nuys airport; the NOAA [M.J. Post] stations – Brown Field and El Centro; the Radian-STI stations – Barstow Meteorological, Riverside H.G. Mills Water District, Temecula East Municipal Water District, Thermal Airport, and Hesperia Oak Hills Center; the U.S. Air Force stations – three sites at Vandenberg Air Force Base. To study nocturnal jets and other meteorological phenomena closer to the ground, the TC and the Meteorological WG, decided to incorporate sound detection and ranging (sodar) instruments with finer resolution (altitude increments of roughly 75 meters vs. 100 meters for profilers) closer to the ground. The seven station network included the NOAA [William Neff] stations – Los Alamitos, Azusa Meteorological, Santa Clarita, and Vandenberg Air Force Base; San Diego CAPCD station – Warner Springs Meteorological; and U.S. Marines stations – two sites at 29 Palms. Due to ground clutter, the second sodar at 29 Palms was moved to a new location inside the base [Atlas site identification 29PB moved to 29PC]. The RWP-RASS and sodar networks are listed in Tables 5 and 6.

To expand the meteorological resources aloft further and to provide opportunities for QA through platform data intercomparisons, the TC and the Meteorological WG supported more frequent rawinsondes from existing military bases and the National Weather Service sites and added new rawinsonde sites. The thirteen site network included the ARB station – Bakersfield Meteorological; the National Weather Service station – Miramar; the military bases – 29 Palms, Edwards Air Force Base, China Lake, Tustin [El Toro operations moved to Tustin], San Nicolas, Point Mugu, North Island Naval Air Station [launch station moved to Imperial Beach], and Vandenberg Air Force Base, and the CE-CERT stations at UCLA, UC Riverside CE-CERT Facility, and Pomona. Due to security concerns at Pomona, the CE-CERT did not launch midnight sondes in the last two IOP days. Meteorological parameters, particularly temperature and relative humidity data, were available from seven ozonesonde site network from the CE-CERT stations – Anaheim, California State University at Northridge, Valley Center, Pomona, UC CE-CERT Facility, University of Southern California Hancock Building; and from the U.S. Navy station at Point Mugu. Tables 7 and 8 list the SCOS97-NARSTO sonde network.

The TC and the Air Quality WG supplemented the ozonesonde network with two ozone lidars and six instrumented airplanes. The lidars were located at El Monte Airport and at Hesperia. Airplanes were flown from the Montgomery Field – San Diego Cessna 182 and San Diego Navajo; from the El Monte airport – UC Davis Cessna 182 and Cal Tech Pelican aerosol; from the Camarillo airport - STI Aztec; and from Oxnard airport the U.S. Navy Partnavia. Table 9 and 10 provide lists of these lidar stations and airplanes.

The SCOS97-NARSTO Atlas is available from the ARB Research Division on CD-ROM and includes further description, maps, photographs, and on occasion, video of selected sites.

Table 3-1

SCOS97-NARSTO SUPPLEMENTAL OZONE SITES

ID	Name	Address	City	Site No.	(msl)	DD	MM	SS	DD	MM	SS	Height	County	Air Basin
				AIRS	Elev	Latitude			Longitude			Inlet		
CAJB	Cajon Pass-AVES	Between 9785 & 9826 Farmington	Cajon		1298	34	22	31	117	26	52	5 m	San Bernardino	SoCAB
CALB	Calabasas-AVES	Back of Lot on 4241 Balcony Drive	Calabasas		183	34	8	52	118	36	43	5 m	Los Angeles	SoCAB
CATA	Santa Catalina Airport-AVES	6 miles North West of Avalon	Avalon		488	33	24	17	118	24	57	-	Los Angeles	SoCAB
CATI	Santa Catalina Isthmus-AVES	USC Research Station Near Isthmus	Santa Catalina Island		37	33	26	30	118	29	50	-	Los Angeles	SoCAB
PVSP	Palos Verdes-San Pedro Hill-AVES	Reservoir 20 on the Gated Crest Road	San Pedro		442	33	44	45	118	20	15	2 m	Los Angeles	SoCAB
MBLD	Mount Baldy Village	Mt Baldy Rd -past Hill the fork that deadends south	Azusa		1219	34	14	14	17	39	15	-	Los Angeles	SoCAB
LOMP	Lompoc Cabrillo High School	4350 Constellation Road	Lompoc	60830006	0	34	42	39	120	28	11	-	Santa Barbara	SCCAB
CHIN	Children's Health Study Jurupa Valley HS	Bellegrave & Etiwanda (10551 Bellegrave)	Mira Loma	60650008	225	34	0	8	117	31	21	-	Riverside	SoCAB
LKAR	Lake Arrowhead	Rim-of-the-World High School-27400 Hwy 18	Lake Arrowhead	60710007	1829	34	13	57	117	12	29	-	San Bernardino	SoCAB
SNDM	San Dimas	1314 Gladstone	San Dimas	60370006		34	8	15	117	50	0	-	Los Angeles	SoCAB
UCDC	Riverside-UC Agricultural Operations	4919 Canyon Crest-Field 16L	Riverside	60650004	299	33	57	43	117	20	2	-	Riverside	SoCAB
ARCO	ARCO Plaza Tower	515 South Flower	Los Angeles		88	34	3	6	118	15	24	-	Los Angeles	SoCAB
CHIM	Chino-Mira Loma-Union Pacific Auto Yard	4500 Etiwanda	Mira Loma		225	34	0	20	117	30	49	-	Riverside	SoCAB
DIAM	Diamond Bar Right Side of Day Care Center	21865 East Copley Drive	Diamond Bar	60370206	300	33	59	59	117	49	56	-	Los Angeles	SoCAB
SNIC	San Nicolas Island NE Bldg 279	Coastal Road to Building 279	San Nicolas Island		14	33	16	47	119	31	11	-	Ventura	SCCAB
TEHP	Tehachapi Pass-Monolith	Jameson Road opposite Hwy from Monolith	Monolith	60291005	1209	35	6	50	118	22	45	-	Kern	SJVAB
WILS	Mount Wilson	Close to TSU Building	Mount Wilson		1725	34	13	35	118	3	36	-	Los Angeles	SOCAB
TCCC	Temecula	4100 County Rd, Bldg C-County Center	Temecula	6065	427	33	31	38	117	9	39	4 m	Riverside	SoCAB
BLKM	Black Mountain	9606 Laurentian Drive	Black Mountain		473	32	58	54	117	6	56	-	San Diego	SDAB
CLMS	San Clemente Island	Across Eel Point on other side of the N-S Route	San Clemente Island		452	32	54	56	118	29	19	-	San Diego	SDAB
REDM	Red Mountain-RTP Site	Fallbrook Pub Utilities Dist @ 3500 Mission Road	Fallbrook		552	33	24	2	117	11	27	-	San Diego	SDAB
SMPK	San Marcos Peak	Deer Springs to Windsong up to the top	Deer Springs		549	33	11	6	117	7	48	5 m	San Diego	SDAB
PEND	Camp Pendelton (Camp Del Mar)	Site next to 21448 Del Mar Marina	Camp Del Mar		6	33	13	2	117	23	46	3 m	San Diego	SDAB
SOLM	Soledad Mountain	7120 Via Capri	La Jolla		251	32	50	27	117	15	0	4 m	San Diego	SDAB
VCEN	Valley Center-RTP Site-Public Road Dept	Valley Center Rd Cole Grade Rd Gate @ right	Valley Center		366	33	13	57	117	1	28	3 m	San Diego	SDAB
WSPR	Warner Springs - RTP Site	Hwy 79-Puerta La Cruz Road-1/2 mile to camp	Warner Springs		945	33	19	20	116	41	4	3 m	San Diego	SDAB
CAJC	Cajon Pass-MDAQMD	Right Fork of HWY 15, gate at Elevation Sign	Cajon		1311	34	20	56	117	26	49	3 m	San Bernardino	SoCAB
ROSA	Santa Rosa Island A	Ozone Site Near Shore line	Santa Rosa Island	60832012	15	34	1	0	120	3	0	-	Santa Barbara	SCCAB
CERD	Riverside-CECERT	1200 Columbia Avenue	Riverside		285	34	0	1	117	20	10	-	Riverside	SoCAB
LAGP	Laguna Peak		Point Mugu		444	34	6	31	119	3	55	-	Ventura	SCCAB
PMGU	Point Mugu Naval Air Station	Building 552	Oxnard		3	34	7	16	119	7	20	-	Ventura	SCCAB

Table 3-2

SCOS97-NARSTO NOY NETWORK

ID	Name	Address	City	Site No.	(msl)	DD	MM	SS	DD	MM	SS	Height	County	Air Basin
				AIRS	Elev	Latitude			Longitude			Inlet		
CAJB	Cajon Pass-AVES	Between 9785 & 9826 Farmington	Cajon		1298	34	22	31	117	26	52	5 m	San Bernardino	SoCAB
CALB	Calabasas-AVES	Back of Lot on 4241 Balcony Drive	Calabasas		183	34	8	52	118	36	43	5 m	Los Angeles	SoCAB
CHIM	Chino-Mira Loma-Union Pacific Auto Yard	4500 Etiwanda	Mira Loma		225	34	0	20	117	30	49	-	Riverside	SoCAB
DIAM	Diamond Bar Right Side of Day Care Center	21865 East Copley Drive	Diamond Bar	60370206	300	33	59	59	117	49	56	-	Los Angeles	SoCAB
SNIC	San Nicolas Island NE Bldg 279	Coastal Road to Building 279	San Nicolas Island		14	33	16	47	119	31	11	-	Ventura	SCCAB
SVAL	Simi Valley-High School	5400 Cochran Street-Stowe 2nd Gate-Aux Bldg	Simi Valley	61112002	310	34	16	37	118	36	44	5 m	Ventura	SCCAB
29PM	29 Palms	6136 Adobe Road	29 Palms	60710017	604	34	8	31	116	3	18	-	San Bernardino	MDAB
BARS	Barstow	301 Mountain View	Barstow	60710001	690	34	53	41	117	1	26	5 m	San Bernardino	MDAB
AZSA	Azusa	803 North Loren Avenue	Azusa	60370002	183	34	8	9	117	55	22	-	Los Angeles	SoCAB
BANN	Banning	135 North Allesandro	Banning	60650002	640	33	55	16	116	51	30	-	Riverside	SoCAB
LANM	Los Angeles North Main	1630 North Main Street	Los Angeles	60371103	87	34	4	1	118	13	36	-	Los Angeles	SoCAB
ALPN	Alpine	2300 Victoria Drive	Alpine	60731006	603	32	50	32	116	46	6	-	San Diego	SDAB
SOLM	Soledad Mountain	7120 Via Capri	La Jolla		251	32	50	27	117	15	0	4 m	San Diego	SDAB
UCDC	Riverside-UC Agricultural Operations	4919 Canyon Crest-Field 16L	Riverside	60650004	299	33	57	43	117	20	2	-	Riverside	SoCAB

Table 3-3
SCOS97-NARSTO AEROSOL NETWORK

ID	Name	Address	City	Site No.	(msl)	DD	MM	SS	DD	MM	SS	Height	County	Air Basin
				AIRS	Elev	Latitude			Longitude			Inlet		
CHIM	Chino-Mira Loma-Union Pacific Auto Yard	4500 Etiwanda	Mira Loma		225	34	0	20	117	30	49	-	Riverside	SoCAB
CHIN	Children's Health Study Jurupa Valley HS	Bellegrave & Etiwanda (10551 Bellegrave)	Mira Loma	60650008	225	34	0	8	117	31	21	-	Riverside	SoCAB
DIAM	Diamond Bar Right Side of Day Care Center	21865 East Copley Drive	Diamond Bar	60370206	300	33	59	59	117	49	56	-	Los Angeles	SoCAB
AZSA	Azusa	803 North Loren Avenue	Azusa	60370002	183	34	8	9	117	55	22	-	Los Angeles	SoCAB
LANM	Los Angeles North Main	1630 North Main Street	Los Angeles	60371103	87	34	4	1	118	13	36	-	Los Angeles	SoCAB
UCDC	Riverside-UC Agricultural Operations	4919 Canyon Crest-Field 16L	Riverside	60650004	299	33	57	43	117	20	2	-	Riverside	SoCAB
AZSP	Azusa Aerosol-Hunt & Sons Plumbing	780 North Todd Avenue	Azusa		183	34	8	10	117	56	28	-	Los Angeles	SoCAB
RIPR	UC Riverside-Pierce Hall-Roof-UC Campus	Pierce Hall Roof	Riverside		324	33	58	26	117	19	40	-	Riverside	SoCAB
RIVC	UC Riverside-Pierce Hall-Prather Lab-Campus	Pierce Hall-inlets @ 2nd Floor	Riverside		324	33	58	23	117	19	35	-	Riverside	SoCAB
RIRD	UC Riverside-CECERT-Roof Radiometry	1200 Columbia Avenue	Riverside		302	34	0	0	117	20	9	-	Riverside	SoCAB
WILS	Mount Wilson Radiometry	Close to TSU Building	Mount Wilson		1725	34	13	35	118	3	36	-	Los Angeles	SoCAB

Table 3-4
SCOS97-NARSTO VOC NETWORK

ID	Name	Address	City	Site No.	(msl)	DD	MM	SS	DD	MM	SS	Height	County	Air Basin
				AIRS	Elev	Latitude			Longitude			Inlet		
MEXI	Technical University-ITM-Mexicali	Across Carretera Algodones & Aven Ciudad De Monterrey	Mexicali	8000200010		32	37	10	115	23	53	-	Baja California	Mexico
TIRP	Rosarito Playa (Beach)-Tijuana-E End of HS	Pedro Moreno School-3 Blks E Benito Juarez Blvd	Tijuana	800020004	15	32	21	11	117	3	21	-	Baja, Mexico	Mexico
SNIC	San Nicolas Island NE Bldg 279	Coastal Road to Building 279	San Nicolas Island		14	33	16	47	119	31	11	-	Ventura	SCCAB
PTCL	Point Conception	Point Conception Lighthouse	Point Conception	60831012	55	34	27	7	120	27	28	-	Santa Barbara	SCCAB
CATA	Santa Catalina Isthmus Airport		Santa Catalina Island		37	33	26	30	118	29	50	-	Los Angeles	SoCAB
ANAH	Anaheim	1610 South Harbor Boulevard	Anaheim	60590001	45	34	6	1	117	29	32	-	Orange	SoCAB
BRBK	Burbank	228 West Palm Avenue	Burbank	60371002	168	34	10	33	118	18	57	-	Los Angeles	SoCAB
29PM	29 Palms	6136 Adobe Road	29 Palms	60710017	604	34	8	31	116	3	18	-	San Bernardino	MDAB
BARS	Barstow	301 Mountain View	Barstow	60710001	690	34	53	41	117	1	26	5 m	San Bernardino	MDAB
CERD	Riverside-CECERT	1200 Columbia Avenue	Riverside		285	34	0	1	117	20	10	-	Riverside	SoCAB
AZSA	Azusa	803 North Loren Avenue	Azusa	60370002	183	34	8	9	117	55	22	-	Los Angeles	SoCAB
HAWH	Hawthorne	5234 West 120th Street	Hawthorne	60375001	21	33	55	51	118	22	8	-	Los Angeles	SoCAB
PICO	Pico Rivera	3713 San Gabriel	Pico Rivera	60371601	75	34	0	51	118	3	38	-	Los Angeles	SoCAB
SOLM	Soledad Mountain	7120 Via Capri	La Jolla		251	32	50	27	117	15	0	4 m	San Diego	SDAB
ALPN	Alpine	2301 Victoria Drive	Alpine	60731006	603	32	50	32	116	46	6	-	San Diego	SDAB
KRNM	Kearny Mesa-County Operation Center	Ruffin Road - End of Hazard Way	San Diego	60730006	160	32	50	11	117	7	59	5 m	San Diego	SDAB
OJAF	Ojai Forest	Sulphur Mtn Rd before intersection of Wells Cyn Rd	Ojai		610	34	25	22	119	9	23	-	Ventura	SCCAB
PINH	Pine Mountain High Site-August 4-6, 1997	Pine Mt Truck Trail near peak to the left side of the road	Azusa		1383	34	13	25	117	54	3	-	Los Angeles	SoCAB
PINL	Pine Mountain Low Site-September 4-7, 97	middle fork Pine Mt & Rincon Red Box Truck Trails	Azusa		1311	34	13	34	117	54	32	-	Los Angeles	SoCAB
MBLD	Mount Baldy Village-Sep 28-29 & Oct 3-4	Mt Baldy Rd -past Hill the fork that deadends south	Mt. Baldy Village	60710217	1219	34	14	14	17	39	15	-	San Bernardino	SoCAB
BANN	Banning	135 North Allesandro	Banning	60650002	640	33	55	16	116	51	30	-	Riverside	SoCAB

Table 3-5
SCOS97-NARSTO RWP-RASS NETWORK

ID	Name	Address	City	Site No.	(msl)	DD	MM	SS	DD	MM	SS	County	Air Basin
				AIRS	Elev	Latitude			Longitude				
EMAM	El Monte Airport-RWP-RASS		El Monte		91	34	4	12	118	2	0	Los Angeles	SoCAB
NAFB	Norton Air Force Base		Norton AFB		320	34	9	12	117	15	0	San Bernardino	SoCAB
ALPM	Alpine-Met		Alpine		463	32	51	53	116	48	27	San Diego	SDAB
BRWN	Brown Field		Brown Field Airport		160	32	34	20	116	58	46	San Diego	SDAB
CARL	Carlsbad		Carlsbad		110	33	8	22	117	16	0	San Diego	SDAB
CATM	Santa Catalina-Met-USC Research Station	USC Research Station Near Isthmus	Santa Catalina Island		37	33	26	44	118	28	56	Los Angeles	SoCAB
ECNT	El Centro		El Centro		-15	32	40	12	115	29	20	Imperial	SSAB
GOLE	Goleta		Goleta		3	34	25	46	119	50	47	Santa Barbara	SCCAB
HUEN	Port Hueneme		Oxnard		2	34	9	54	119	13	8	Ventura	SCCAB
LOSM	Los Alamitos		Los Alamitos		7	33	47	18	118	2	56	Orange	SoCAB
PALD	Palmdale		Palmdale		777	34	36	46	118	5	26	Los Angeles	SoCAB
SCLM	San Clemente Island-Met		San Clemente Island		53	33	1	7	118	35	7	San Diego	SDAB
TUST	Tustin		Tustin		16	33	42	25	117	50	15	Orange	SoCAB
USCZ	USC-Hancock Fnd Bldg	3616 Trousdale Parkway	Los Angeles		67	34	1	10	118	17	2	Los Angeles	SoCAB
VNUY	Van Nuys Airport		Van Nuys		241	34	12	57	118	29	31	Los Angeles	SoCAB
BARM	Barstow-Met	12 Guage Lake-10000 Ming Avenue	Barstow		694	34	55	23	117	18	25	San Bernardino	MDAB
HESO	Hesperia-Oak Hills Center	19709 Yanan Road	Apple Valley		975	34	23	29	117	24	17	San Bernardino	MDAB
RIHM	Riverside-H.J.Mills Water District	550 E. Alessandro Blvd.	Riverside		488	33	55	0	117	18	30	Riverside	SoCAB
THRM	Thermal Airport	56860 Higgins Drive	Thermal		-39	33	38	25	116	9	35	Riverside	SoCAB
TMCM	Temecula-East Municipal Water District	P.O. Box 8300	San Jacinto		335	33	30	0	117	9	40	Riverside	SoCAB
LAXP	Los Angeles Airport		Los Angeles		47	33	56	24	118	26	10	Los Angeles	SoCAB
ONTP	Ontario Airport		Ontario		290	34	3	22	117	36	11	San Bernardino	SoCAB
ESCM	Valley Center Met-Miller Pumping Station	Valley Center Muni Water Dist-Dermid Rd End	Valley Center		305	33	15	19	117	2	40	San Diego	SDAB
PTLP	Point Loma	End of Propogation-Building 599	Point Loma		30	32	41	48	117	15	15	San Diego	SDAB
VBG	Vandenberg Air Force Base		Vandenberg AFB		364	34	45	0	120	34	12	Santa Barbara	SCCAB
SVLM	Simi Valley Met - Madero Road Landfill*	End of Madero Road North	Simi Valley	61110008	366	34	17	27	118	47	52	Ventura	SCCAB

Table 3-6
SCOS97-NARSTO SODAR NETWORK

ID	Name	Address	City	Site No.	(msl)	DD	MM	SS	DD	MM	SS	County	Air Basin
				AIRS	Elev	Latitude			Longitude				
AZSM	Azusa-Met		Azusa		232	34	9	37	117	54	17	Los Angeles	SoCAB
CLAR	Santa Clarita Valley		Santa Clarita		450	34	25	27	118	31	37	Los Angeles	SoCAB
WSPM	Warner Springs - Met Site	Hwy 79-Puerta La Cruz Road-1 mile from hwy	Warner Springs		945	33	19	5	116	41	3	San Diego	SDAB
VBG	Vandenberg Air Force Base		Vandenberg AFB		364	34	45	0	120	34	12	Santa Barbara	SCCAB
29PA	29 Palms-Sand Hill-Turtle Site	29 Palms Marines Base-Air Ground Combat Center	29 Palms		764	34	18	40	116	15	10	San Bernardino	MDAB
29PB	29 Palms-Expeditionary Air Field (<8/20/97)	29 Palms Marines Base-Air Ground Combat Center	29 Palms		610	34	17	50	116	9	47	San Bernardino	MDAB
29PC	29 Palms-Expeditionary Air Field (>8/20/97)	29 Palms Marines Base-Air Ground Combat Center	29 Palms		619	34	17	53	116	10	15	San Bernardino	MDAB
LOSM	Los Alamitos		Los Alamitos		7	33	47	18	118	2	56	Orange	SoCAB

Table 3-7
SCOS97-NARSTO RAWINSONDE NETWORK

ID	Name	Address	City	Site No.	(msl)	DD	MM	SS	DD	MM	SS	County	Air Basin
				AIRS	Elev	Latitude			Longitude				
BAKM	Bakersfield-Met	1031 Mount Vernon Avenue	Bakersfield		99	35	20	44	118	57	59	Kern	SJVAB
RIRD	Riverside-CECERT-Facility	1200 Columbia Avenue	Riverside		302	34	0	0	117	20	9	Riverside	SoCAB
UCLA	UCLA-Met-Math Science Building	425 N. Hilgard Ave-Circle Drive-West of Franz Hall	Los Angeles		122	34	4	11	118	25	59	Los Angeles	SoCAB
NKX	Miramar National Weather Service Launch	Kearny Villa Rd North 1 mile Soledad Fwy right gate	Miramar		137	32	52	43	117	7	25	San Diego	SDAB
POMN	Pomona-security concern-last IOP no PM launch	Gary Avenue	Pomona		274	34	4	31	117	45	1	Los Angeles	SoCAB
EDWD	Edwards AFB		Edwards		723	34	54	0	117	54	0	Kern	MDAB
VBG	Vandenberg Air Force Base		Vandenberg AFB		364	34	45	0	120	34	12	Santa Barbara	SCCAB
29PD	29 Palms-Expeditionary Air Field	29 Palms Marines Base-Air Ground Combat Center	29 Palms		611	34	10	48	116	5	24	San Bernardino	MDAB
TUSR	Tustin MCAS		Tustin		17	33	42	0	117	50	0	Orange	SoCAB
CHLK	China Lake Naval Air Warfare Center	Armitage Field	China Lake		665	35	45	0	117	40	48	Kern	MDAB
NALF	Imperial Beach/Alt Site for NVAS Launches	Naval Auxiliary Field	San Diego	60734001	9	32	34	58	117	7	8	San Diego	SDAB
NVAS	Naval Air Station-North Island	Halsey Field	San Diego		0	32	20	24	117	4	12	San Diego	SDAB
PMGU	Point Mugu Naval Air Station	Building 552	Oxnard		3	34	7	16	119	7	20	Ventura	SCCAB
SNIC	San Nicolas Island NE Bldg 279	Coastal Road to Building 279	San Nicolas Island		14	33	16	47	119	31	11	Ventura	SCCAB

Table 3-8
SCOS97-NARSTO OZONESONDE NETWORK

ID	Name	Address	City	Site No.	(msl)	DD	MM	SS	DD	MM	SS	County	Air Basin
				AIRS	Elev	Latitude			Longitude				
CSUN	Cal State Northridge	18111 Nordhoff Street-Building	Northridge		267	34	14	13	118	31	47	Los Angeles	SoCAB
USCZ	USC-Hancock Fnd Bldg	3616 Trousdale Parkway	Los Angeles		67	34	1	10	118	17	2	Los Angeles	SoCAB
VCNO	Valley Center-CE-CERT Ozone Sonde	29216 Valley Center	Valley Center		366	33	13	57	117	1	28	San Diego	SDAB
ANAH	Anaheim	1610 South Harbor Boulevard	Anaheim	60590001	45	34	6	0.9	117	29	31.5	Orange	SoCAB
POMA	Pomona-security concern-last IOP no night launch	924 North Gary Avenue	Pomona	60371701	274	34	4	2	117	45	7	Los Angeles	SoCAB
ULDS	Upland - moved after training	1350 San Bernardino Aven Sp 62	Upland	60711003	379	34	5	52	117	39	0	Riverside	SoCAB
ESCO	Valley Center (Escondido)	600 East Valley Parkway-	Escondido	60731002	415	33	12	57	117	7	43	San Diego	SDAB
PMGU	Point Mugu Naval Air Station	Building 552	Oxnard		3	34	7	16	119	7	20	Ventura	SCCAB

Table 3-9
SCOS97-NARSTO LIDAR Sites

ID	Name	Address	City	(msl)	DD	MM	SS	DD	MM	SS	County	Air Basin
				Elev	Latitude			Longitude				
EMAL	El Monte Airport-Lidar		El Monte	91	34	4	12	118	2	0	Los Angeles	SoCAB
HESL	Hesperia-Lidar @ Oak Hills Water Tank	Oak Hills Road 2 Miles south of HWY 15 HWY 395 Exit	Hesperia	1175	34	23	28	117	26	10	San Bernardino	MDAB

Table 3-10
SCOS97-NARSTO AIRPLANES

ID	Name	Address	City	(msl)	DD	MM	SS	DD	MM	SS	County	Air Basin
				Elev	Latitude			Longitude				
CIRP	CIRPAS Pelican @ El Monte Airport		El Monte	91	34	4	12	118	2	0	Los Angeles	SoCAB
SD-C	CESSNA-SDAPCD @ Montgomery Field	6 miles north of San Diego	San Diego	129	32	48	57	117	8	25	San Diego	SDAB
SD-N	NAVAJO @ Montgomery Field	6 miles north of San Diego	San Diego	129	32	48	57	117	8	25	San Diego	SDAB
STIA	AZTEC @ Camarillo Airport		Camarillo	23	34	12	49	119	5	39	Ventura	SCCAB
UCDA	CESSNA-UC Davis @ El Monte		El Monte	91	34	4	12	118	2	0	Los Angeles	SoCAB
USNP	Partnavia US Navy @ Oxnard Airport		Oxnard	13	34	12	2	119	12	25	Ventura	SCCAB

3.2 Existing Surface Air Quality and Meteorological Monitoring Sites

The Routine Network is the network of air quality and meteorological data gathering stations in the SCOS97-NARSTO domain – South Coast, San Diego, South Central Coast, Mojave Desert, Salton Sea, and southern parts of San Joaquin Valley air basins – that report their data to AIRS. As noted before, parameters measured at each existing site are available from the United States Environmental Protection Agency's Aerometric Information Retrieval System (AIRS) and appendices A and B Volume I of this document. Please also note that the best reference document on particulars of working with AIRS stations in southern California is the annual ARB State and Local Air Monitoring Network Plan. Tables 1 to 6 provide details of stations within each air basin with the SCOS97-NARSTO domain.

The South Coast AQMD has closed many stations within the last three years – Commerce-61st Street, Commerce AT&SF Railroad, Commerce-Ayers Avenue, Diamond Bar, Industry-Clark, Industry-Don Julian, Industry-Volkswagon, Santa Fe Springs, Hemet, Norco, and Temecula. Some stations operate to monitor one or two air quality parameters sometimes due to their compliance status [Riverside Magnolia and Ontario Airport]. The SCAQMD has also operated Jurupa Valley High School, Lake Arrowhead, San Dimas, and the UC Riverside Agricultural Experimental stations at the behest of the Children's Health Study Program. Data from these stations, as well as certain specialty aerosol data, are not reported to AIRS.

The San Diego CAPCD operates the Soledad Mountain site on a semi-permanent basis and works closely with the Children's Health Study program for operations at Alpine. The San Diego CAPCD only operates the Union Street site for carbon monoxide monitoring.

Many aerosol sites in the Mojave Desert air basin – China Lake Power Line, Inyokern Airport, Ridgecrest Las Flores Avenue, and Tehachapi Jameson Road – have not submitted data to AIRS for the SCOS97-NARSTO period. The Children's Health Study program also operates at Lancaster.

Salton Sea air basin sites – Bombay Beach, Brawley, Mesquite, Niland, Seeley, Westmoreland, and Winterhaven – did not supply ozone or aerosol data to AIRS. All except the last two did not commence operations as planned.

South Central Coast air basin Routine Network is managed by Santa Barbara, San Luis Obispo, and Ventura CAPCDs. In the past three years, San Luis Obispo CAPCD has closed Nipomo South Wilson Street and San Luis Obispo Lewis stations. The Atascadero site is part of the Children's Health Study program. Santa Barbara CAPCD has closed Battles Betteravia Road, Gaviota A, Jalama Beach, and Vandenberg Air Force Base Point Arguello and Watt Road stations. The Santa Maria Library site is not closed but offers no information during the SCOS97-NARSTO study. Las Flores Canyon sites 2 and 3 only provide information on nitrogen and sulfur dioxides. Ventura CAPCD has closed the Ventura East Main Street site and has moved the Ojai station to the Ojai Avenue Fire Station.

Certain Kern county portions of the San Joaquin Valley air basin were also part of the SCOS97-NARSTO domain. ARB operates Arvin, Bakersfield California Street, Oildale, and Shafter stations and San Joaquin UAPCD operates Bakersfield Golden State and Maricopa sites. These stations' data at AIRS provides background information on meteorology and on air quality in southern California and helps data analysts and modelers to understand the context of SCOS97-NARSTO.

The SCOS97-NARSTO meteorological modeling begins with domains much larger than the study domain. The SCOS97-NARSTO surface routine meteorological networks do exceed the geographical study domain so that their data can be used as inputs to SCOS97-NARSTO meteorological models. These networks are described in detail in volume V of this document.

These meteorological networks have not been designed and are not operated to provide information for air quality planning. Consequently, there is significant variability in the type of data collected, on meteorological parameters of interest, and on the QA aspects of their operation. The California water control resources boards have run the CIMIS network, to gather data for preservation of water and soil resources and for watershed planning. The National Weather Service sites provide data for weather forecasting, fire prevention, road safety, air traffic, ocean navigation, and preparation for natural emergencies. The National Park Service stations are designed to monitor and to maintain the health and the vitality of the wild flora and fauna at the national parks. The NPS Air Resources Division, in partnership with parks and others, works to preserve, protect, enhance, and understand air quality and other resources sensitive to air quality in the National Park System. Their world wide web site provides access to resources such as the IMPROVE network and other U.S. government monitoring programs. The US Forest Service stations have a function similar to the National Parks network and the selection noted in the SCOS97-NARSTO atlas is concentrated in the SoCAB and SCCAB. The US Navy sites have national security purposes and the selection noted in the SCOS97-NARSTO atlas are concentrated in the SCCAB and the SDAB. The United States Department of Interior Bureau of Land Management meteorological stations have been in operation to monitor preservation and wise use of national resources. Finally, the CCOHD and the MCOHD meteorological networks include a few sites in the SCOS97-NARSTO domain. CCOHD is mostly centered around Las Vegas and Henderson, Nevada. MCOHD stations are mostly around Phoenix Arizona. CIMIS data is available from the California department of Water Resources. With some exceptions, data from other sites are available through the Western Regional Climate Center (WRCC). The site locations, names, and designations are subject to change without notice and many sites may be moved taken out of operation, or combine, and new sites can be added. For the best and most current information, please consult WRCC at DRI.

The existing meteorological and air quality networks in southern California provide the background data useful to analysis and modeling of the SCOS97-NARSTO study. There are so many stations that data from nearby sites can be compared for quality control purposes. For example, the CIMIS, and the Children's Health Study-SCAQMD produce meteorological data at UC Riverside Agricultural Experimental station. The SCOS97-NARSTO atlas is recommended as a resource to guide these types of data comparison.

Table 3.2-1
SOUTH COAST AIR BASIN ROUTINE NETWORK

ID	Name	Address	City	Site No.	(msl)	DD	MM	SS	DD	MM	SS	County
				AIRS	Elev	Latitude			Longitude			
AZSA	Azusa	803 North Loren Avenue	Azusa	60370002	183	34	8	9	117	55	22	Los Angeles
BRBK	Burbank	228 West Palm Avenue	Burbank	60371002	168	34	10	33	118	18	57	Los Angeles
GLDR	Glendora	840 Laurel	Glendora	60370016	275	34	8	40	117	51	0.3	Los Angeles
HAWH	Hawthorne	5234 West 120th Street	Hawthorne	60375001	21	33	55	51	118	22	8	Los Angeles
LANM	Los Angeles North Main	1630 North Main Street	Los Angeles	60371103	87	34	4	1	118	13	36	Los Angeles
NLGB	Long Beach	3648 N Long Beach	Long Beach	60374002	6	33	49	27	118	11	0.2	Los Angeles
PDSW	Pasadena	752 S. Wilson Ave	Pasadena	60372005	250	34	5	2	118	6	28	Los Angeles
PICO	Pico Rivera	3713 San Gabriel	Pico Rivera	60371601	75	34	0	51	118	3	38	Los Angeles
POMA	Pomona	924 North Gary Avenue	Pomona	60371701	274	34	4	2	117	45	7	Los Angeles
RSDA	Reseda	18330 Gault St	Reseda	60371201	226	34	11	57	118	31	58	Los Angeles
SCLR	Santa Clarita	San Fernando Rd-County Fire Station	Santa Clarita	60376002	375	34	23	16	118	32	2	Los Angeles
VALA	West Los Angeles	VA Hospital	Los Angeles	60370113	91	34	3	2.7	118	27	24	Los Angeles
LYNW	Lynwood	11220 Long Beach Blvd	Lynwood	60371301	27	33	55	44	118	12	35	Los Angeles
ANAH	Anaheim	1610 South Harbor Boulevard	Anaheim	60590001	45	34	6	0.9	117	29	32	Orange
CMMV	Costa Mesa	2850 Mesa Verde Dr	Costa Mesa	60591003	25	33	40	29	117	55	47	Orange
ELTR	El Toro	23022 El Toro Road		60592001	137	33	37	38	117	41	28	Orange
LHAB	La Habra	621 W. Lambert	La Habra	60595001	82	33	55	33	117	57	3	Orange
BANN	Banning	135 North Allesandro	Banning	60650002	722	33	55	16	116	51	30	Riverside
LELS	Lake Elsinore	506 W Flint St	Lake Elsinore	60659001	440	33	40	35	117	19	51	Riverside
PERR	Perris	237.5 N "D" St	Perris	60656001	439	33	47	20	117	13	39	Riverside
RIVM	Riverside	7002 Magnolia Ave	Riverside	60651003	249	33	56	45	117	24	0	Riverside
RUBI	Rubidoux	5888 Mission Blvd	Riverside	60658001	250	34	0	35	117	25	33	Riverside
FONT	Fontana	14360 Arrow Blvd	Fontana	60712002	381	34	6	0.8	117	29	24	San Bernardino
LGRE	Crestline-Lake Gregory	Lake Dr	Crestline	60710005	1384	34	14	38	117	16	26	San Bernardino
ONTX	Ontario Airport		Ontario	60716001	330	34	3	16	117	35	16	San Bernardino
RDLD	Redlands	500 N. Dearborn	Redlands	60714003	481	34	3	35	117	9	35	San Bernardino
SANB	San Bernardino	24302 4th St	San Bernardino	60719004	336	34	6	24	117	16	25	San Bernardino
ULDS	Upland	1350 San Bernardino Aven Sp 62	Upland	60711003	379	34	5	52	117	39	0	San Bernardino

Table 3.2-2

SAN DIEGO AIR BASIN ROUTINE NETWORK

ID	Name	Address	City	Site No.	(msl)	DD	MM	SS	DD	MM	SS	County
				AIRS	Elev	Latitude			Longitude			
ALPN	Alpine	2301 Victoria Drive	Alpine	60731006	603	32	50	32	116	46	6.4	San Diego
CHVT	Chula Vista	80 E "J" St	San Diego	·60730001	56	33	49	13	117	54	48	San Diego
DMMC	Del Mar Mira Costa College	225 Ninth Street	Del Mar	60731001	35	32	57	10	117	15	46	San Diego
ECAJ	El Cajon	1155 Redwood Ave	El Cajon	60730003	143	32	47	27	116	56	33	San Diego
ESCO	Valley Center (Escondido)	600 East Valley Parkway-	Escondido	60731002	204	33	12	57	117	7	43	San Diego
OCEA	Oceanside	1701 Mission Ave	Oceanside	60730005	37	33	12	10	117	22	1	San Diego
OTAY	Otay	1100 Paseo International	Otay	60732007	155	32	35	2	116	56	16	San Diego
PEND	Camp Pendelton (Camp Del Mar)	Site next to 21448 Del Mar Marina	Camp Del Mar	60731008	6	33	13	2	117	23	46	San Diego
SD12	San Diego	330A 12TH AVE	San Diego	60731007	6	32	42	32	117	9	10	San Diego
SDOV	San Diego	5555 Overland Ave	San Diego	60730006	135	32	49	40	117	7	58	San Diego
SDUN	San Diego	1133 Union St	San Diego	60730007	15	32	43	1	117	9	53	San Diego

Table 3.2-3

MOJAVE DESERT AIR BASIN ROUTINE NETWORK

ID	Name	Address	City	Site No.	(msl)	DD	MM	SS	DD	MM	SS	County
				AIRS	Elev	Latitude			Longitude			
LANC	Lancaster	315 West Pondera Street, Suite C	Lancaster	60379002	725	34	41	25	118	7	59	Los Angeles
MOJP	Mojave	923 Poole St	Mojave	60290011	853	35	3	1	118	8	53	Kern
29PM	29 Palms	6136 Adobe Road	29 Palms	60710017	604	34	8	31	116	3	18	San Bernardino
BARS	Barstow	301 Mountain View	Barstow	60710001	690	34	53	41	117	1	26	San Bernardino
HESP	Hesperia	17288 Olive St	Hesperia	60714001	1006	34	24	57	117	17	9.8	San Bernardino
JOSL	Joshua Tree National Monument	Lost Horse Mtn-moved to Black Rock Cyn 1993	Joshua Tree	60719002	1244	34	4	17	116	23	26	San Bernardino
LUCN	Lucern Valley	Lucern Valley Middle School-8560 Aliento	Lucern Valley	60710013	1036	34	24	30	116	54	25	San Bernardino
PHEL	Phelan	Beekley & Phelan Rds	Phelan	60710012	1250	34	25	29	117	35	25	San Bernardino
TRNA	Trona Athol	83732 Trona Rd	Trona	60710015	498	35	46	27	117	22	7.1	San Bernardino
VICT	Victorville	14029 Amargosa Rd	Victorville	60710014	876	34	30	15	117	19	47	San Bernardino

Table 3.2-4

SALTON SEA AIR BASIN ROUTINE NETWORK

ID	Name	Address	City	Site No.	(msl)	DD	MM	SS	DD	MM	SS	County
				AIRS	Elev	Latitude			Longitude			
CLXC	Calexico Grant Street	900 Grant St	Calexico	60250004	0	32	40	27	115	30	56	Imperial
CALE	Calexico Ethel Street	Calexico High School Ethel Street	Calexico	60250005	1	32	40	35	115	28	60	Imperial
CLXE	Calexico East		Calexico	60250006		32	40	29	115	23	28	Imperial
EC9S	El Centro	150 9th St	El Centro	60251003	0	32	47	38	115	33	45	Imperial
INDO	Indio	46-990 Jackson St	Indio	60652002	-6	33	42	30	116	12	57	Riverside
PALM	Palm Springs	FS 590 Racquet CL	Palm Springs	60655001	171	33	51	17	116	32	31	Riverside

Table 3.2-5

SOUTH CENTRAL COAST AIR BASIN ROUTINE NETWORK

ID	Name	Address	City	Site No.	(msl)	DD	MM	SS	DD	MM	SS	County
				AIRS	Elev	Latitude			Longitude			
ARGR	Arroyo Grande	Ralcoa Way	Arroyo Grande	60791005	300	35	2	38	120	34	51	San Luis Obispo
ATAS	Atascadero	6005 Lewis Ave	Atascadero	60798001	860	35	29	31	120	40	5.2	San Luis Obispo
GCTY	Grover City	9 Lesage Dr	Grover City	60792001	5	35	7	30	120	37	58	San Luis Obispo
MOBY	Morro Bay	Morro Bay BL & Kernr	Morro Bay	60793001	18	35	22	0.7	120	50	42	San Luis Obispo
NIPO	Nipomo	1300 Guadalupe Rd	Nipomo	60792004	60	35	1	19	120	34	8	San Luis Obispo
PSRB	Paso Robles	235 Santa Fe Ave	Paso Robles	60790005	100	38	34	0	121	29	0	San Luis Obispo
SLOM	San Luis Obispo	1160 Marsh St	San Luis Obispo	60792002	66	35	17	2	120	39	14	San Luis Obispo
CPGB	Carpinteria	Gobernador Rd	Carpinteria	60831021	137	34	24	12	119	27	29	Santa Barbara
ECSP	El Capitan State Park			60830008	39	34	27	45	120	1	28	Santa Barbara
GAVE	Gaviota East	N of Chevron Plant	Gaviota	60831016	105	34	28	40	120	12	23	Santa Barbara
GAVW	Gaviota West		Gaviota	60831015	91	34	28	41	120	12	39	Santa Barbara
GLWF	Goleta	380 W Fairview Ave	Goleta	60832011	50	34	26	44	119	49	44	Santa Barbara
GTCB	Nojoqui Pass	GTC B HWY 101	Gaviota	60831018	305	34	31	39	120	11	44	Santa Barbara
GTCC	Gaviota	GTC C 1 Mile E of Plant	Gaviota	60831019	82	34	28	30	120	11	20	Santa Barbara
LFC1	Capitan LFC #1		Las Flores Canyon	60831025	189	34	29	23	120	2	45	Santa Barbara
LFC2	Capitan LFC #2		Las Flores Canyon	60831026	257	34	28	46	120	1	57	Santa Barbara
LFC3	Capitan LFC #3		Las Flores Canyon	60831027	146	34	28	9	120	2	22	Santa Barbara
LOMP	Lompoc Cabrillo High School	4350 Constellation Road	Lompoc	60830006	0	34	42	39	120	28	11	Santa Barbara

LOSP	Los Padres National Forest	Paradise Rd	Los Padres Forest	60831014	547	34	32	29	119	47	26	Santa Barbara
LPHS	Lompoc	HS&P Facility 500 meters SW	Lompoc	60831013	220	34	43	32	120	25	40	Santa Barbara
LPSH	Lompoc	C-128 S 'H' St	Lompoc	60832004	32	34	38	16	120	27	24	Santa Barbara
PTCL	Point Conception Light House	Point Conception Lighthouse	Point Concepcion	60831012	55	34	27	7	120	27	28	Santa Barbara
ROSA	Santa Rosa Island A	Ozone Site Near Shore line	Santa Rosa Island	60832012	15	34	1	0	120	3	0	Santa Barbara
SBWC	Santa Barbara	3 W. Carrillo St	Santa Barbara	60830010	71	34	25	15	119	42	3	Santa Barbara
SMSB	Santa Maria Broadway	500 S Broadway	Santa Maria	60831007	57	34	56	54	120	26	2.8	Santa Barbara
SMSL	Santa Maria Library	Library	Santa Maria	60834001	57	34	56	56	120	26	4	Santa Barbara
SYAP	Santa Ynez	Airport Rd	Santa Ynez	60833001	210	34	36	30	120	4	23	Santa Barbara
UCSB	UCSB West Campus	ARCO Tank, IS	Santa Barbara	60831020	9	34	24	55	119	52	43	Santa Barbara
VBPP	Vandenberg Air Force Base	STS Power Plant	Vandenberg AFB	60834003	104	34	35	45	120	37	49	Santa Barbara
ELRO	El Rio	El Rio-Rio Mesa School No. 2	El Rio	61113001	34	34	15	53	119	8	2	Ventura
EMMA	Emma Wood State Beach			61112003	3	34	16	50	119	18	55	Ventura
OJAI	Ojai	1201 Ojai Road	Ojai	61111004	305	34	26	53	119	13	52	Ventura
PRTG	Piru	2SW-2815 Telegraph Rd	Piru	61110004	182	34	23	56	118	49	26	Ventura
SVAL	Simi Valley-High School	5400 Cochran Street-Stowe 2nd Gate-Aux Bldg	Simi Valley	61112002	310	34	16	37	118	36	44	Ventura
THOS	West Casitas Pass-Oak View	5500 Casitas Pass Rd	Casitas Pass	61110005	320	34	23	13	119	24	57	Ventura
TOMP	Thousand Oaks	9 2323 Moorpark	Thousand Oaks	61110007	232	34	12	35	118	52	8	Ventura

Table 3.2-6
SAN JOAQUIN VALLEY AIR BASIN - SCOS97-NARSTO DOMAIN - ROUTINE NETWORK

ID	Name	Address	City	Site No.	(msl)	DD	MM	SS	DD	MM	SS	County
				AIRS	Elev	Latitude			Longitude			
ARVN	Arvin	20401 Bear Mountain Blvd.	Arvin	60295001	145	35	12	32	118	46	35	Kern
BLFC	Bakersfield	5558 California St	Bakersfield	60290014	114.6	35	21	21	119	2	23	Kern
EDSN	Edison	Johnson Fram	Edison	60290007	425	35	20	45	118	51	3	Kern
OLDL	Oildale	3311 Manor St	Oildale	60290232	180	35	26	20	119	0	57	Kern
SHFT	Shafter	548 Walker Street	Shafter	60296001	126	35	30	14	119	16	19	Kern
BKGS	Bakersfield	1138 Golden State	Bakersfield	60290010	151	35	23	5	119	0	53	Kern
MRCP	Maricopa	755 Stanislaus Street	Maricopa	60290008	289	35	8	16	19	24	14	Kern

Table 3.2-7
CIMIS SURFACE ROUTINE METEOROLOGICAL NETWORK
Table 3.2-7

ID	Name	Address	City	CIMIS	(msl)	DD	MM	SS	DD	MM	SS	County	Air Basin
				No.	Elev	Latitude			Longitude				
ARED	Arvin	Edison	Arvin	125	46	35	12	22	118	46	40	Kern	SJVAB
BKWC	Blackwells Corner	Hwy 33 & Hwy 46	Lost Hills	54	215	35	38	59	119	57	30	Kern	MDAB
BRST	BARSTOW NE		Barstow	134	189	34	53	3	116	59	0	Kern	MDAB
BLHT	BLYTHE NE		Blythe	135	26	33	33	24	114	39	59	Riverside	MDAB
BSHP	Bishop		Bishop	35	387	37	21	29	118	24	14	Inyo	GBVAB
CAMB	Calipatria	Mulberry	Calipatria	41	-33	33	2	37	115	24	56	Imperial	SSAB
CATH	Cathedral City		Cathedral City	118	12	33	50	33	116	28	44	Imperial	SSAB
CLRM	Claremont		Claremont	82	494	34	7	48	117	41	46	Los Angeles	SoCAB
CUYA	Cuyama		Cuyama	88	698	34	55	54	119	36	17	Santa Barbara	SCCAB
ELDO	El Dorado		Los Alamitos	102	5	33	47	50	118	5	38	Orange	SoCAB
ESCD	Escondido		Escondido	74	137	33	5	24	116	58	52	San Diego	SDAB
FRBH	Firebaugh	Telles	Firebaugh	7	56	36	51	4	120	35	25	Fresno	SJVAB
FSU	Fresno State		Fresno	80	103	36	49	15	119	44	31	Fresno	SJVAB
FVPT	Five Points	WSFS United States Department of Agriculture	USDA	2	87	36	20	11	120	6	47	Fresno	SJVAB
GAFH	Goleta Foothills		Goleta	94	195	34	28	18	119	52	4	Santa Barbara	SCCAB
GLEL	GLENDALE		Glendale	133	103	33	34	8	112	11	23	Los Angeles	SoCAB
GUAD	Guadalupe		Guadalupe	120	34	34	57	42	120	32	48	Santa Barbara	SCCAB
HAST	Dozier	Hastings Tract & Salena Road	Dozier	122	1	38	16	57	121	47	24	Solano	SJVAB

HOPL	Hopland Forest		Hopland	85	354	39	0	25	123	4	45	Mendocino	NCAB
IRVI	Irvine		Irvine	75	125	33	41	19	117	43	14	Orange	SoCAB
KEST	Kesterson		Kesterson	92	23	37	13	57	120	52	48	Merced	SJVAB
KETT	Kettleman City		Kettleman City	21	104	35	52	8	119	53	39	Kings	SJVAB
LIND	Lindcove		Lindcove	86	146	36	21	26	119	3	31	Tulare	SJVAB
LODI	Lodi		Lodi	42	7	38	6	34	121	20	46	San Joaquin	SJVAB
LOSB	Los Banos		Los Banos	56	29	37	5	30	120	45	35	Merced	SJVAB
MANT	Manteca		Manteca	70	10	37	50	5	121	13	22	San Joaquin	SJVAB
MELO	Meloland		Meloland	87	-14	32	48	24	115	26	46	Imperial	SSAB
MODE	Modesto		Modesto	71	11	37	38	10	121	11	10	San Joaquin	SJVAB
OASS	OASIS		Oasis	136	1	33	31	32	116	9	15	Riverside	SSAB
OCSD	Oceanside		Oceanside	49	15	33	15	21	117	19	11	San Diego	SDAB
PANO	Panoche		Panoche	124	56	36	53	25	120	43	55	San Benito	NCCAB
PIRU	Piru		Piru	101	195	34	22	30	118	47	20	Ventura	SCCAB
PLVD	Palo Verde		Palo Verde	72	70	33	23	15	114	43	21	Imperial	SSAB
POMO	Pomona		Pomona	78	223	34	3	30	117	48	42	Los Angeles	SoCAB
PRLR	Parlier		Parlier	39	103	36	35	52	119	30	11	Fresno	SJVAB
PTHU	Port Hueneme		Port Hueneme	97	5	34	10	24	119	12	0	Ventura	SCCAB
RAMO	Ramona		Ramona	98	409	33	2	58	116	56	18	San Diego	SDAB
SAND	SAN DIEGO		San Diego	66	34	32	43	59	117	8	5	San Diego	SDAB
SELY	Seeley		Seeley	68	12	32	45	34	115	43	54	Imperial	SSAB
SHAF	Shafter	USDA	Shafter	5	110	35	31	59	119	16	52	Kern	SJVAB
SLOP	San Luis Obispo		San Luis Obispo	52	101	35	18	22	120	39	37	San Luis Obispo	SCCAB
SLTE	Salton Sea East		Salton Sea	128	-20	33	13	12	115	34	48	Imperial	SSAB
SLTW	Salton Sea West		Salton Sea	127	-20	33	19	38	115	57	0	Imperial	SSAB
SNBA	Santa Barbara		Santa Barbara	107	76	34	26	16	119	44	10	Santa Barbara	SCCAB
SNTM	Santa Maria		Santa Maria	38	82	34	57	16	120	23	3	Santa Barbara	SCCAB
SNTY	Santa Ynez		Santa Ynez	64	149	34	34	59	120	4	41	Santa Barbara	SCCAB
STAM	Santa Monica		Santa Monica	99	104	34	2	28	118	28	34	Los Angeles	SoCAB
STRA	Stratford		Stratford	15	59	36	9	27	119	51	0	Kings	SJVAB
TEME	Temecula		Temecula	62	433	33	29	25	117	13	20	Riverside	SoCAB
THER	Thermal		Thermal	50	-8	33	38	47	116	14	30	Riverside	SoCAB
TME2	Temecula-East		Temecula	130	457	33	33	23	117	2	13	Riverside	SoCAB
UCR	UC Riverside		Riverside	44	311	33	57	54	117	20	8	Riverside	SoCAB
VSLA	Visalia	ICI Americas	Visalia	33	107	36	18	3	119	13	23	Tulare	SJVAB

VTRV	Victorville		Victorville	117	269	34	28	42	117	15	40	San Bernardino	MDAB
WTLD	Westlands		Westlands	105	58	36	38	0	120	22	55	Fresno	SJVAB

Table 3.2-8
NATIONAL WEATHER SERVICE ROUTINE METEOROLOGICAL NETWORK

ID	Name	City	(msl)	DD	MM	SS	DD	MM	SS	County	Air Basin
			Elev	Latitude			Longitude				
87Q	San Simeon Point Piedras	San Simeon	6	35	26	56	121	16	48	San Luis Obispo	SCCAB
BFL	Bakersfield	Bakersfield	150	35	35	0	119	3	0	Kern	SJVAB
BIH	Bishop	Bishop	1263	37	22	0	118	22	0	Inyo	GBVAB
BLH	Blythe	Blythe	36	33	37	0	114	43	0	Riverside	MDAB
BUO	Beaumont	Beaumont	792	33	56	0	116	56	0	Riverside	SoCAB
BUR	Burbank	Burbank	223	34	12	0	118	21	30	Los Angeles	SoCAB
BYS	Fort Irwin Barstow Bicycle Lake	Fort Irwin	764	35	18	0	116	39	0	San Bernardino	MDAB
CMA	Camerillo	Camerillo	23	34	12	48	119	5	36	Ventura	SCCAB
CNO	Chino	Chino	198	33	58	30	117	38	12	Riverside	SoCAB
CRQ	Carlsbad	Carlsbad	100	33	7	42	117	16	48	San Diego	SDAB
CZZ	Campo	Campo	245	32	26	0	116	28	0	San Diego	SDAB
DAG	Daggett Barstow Airport	Daggett	540	34	52	0	116	47	0	San Bernardino	MDAB
DRA	Desert Rock Airfield	Private Airfield	365	36	30	0	115	50	0	Nevada	Nevada
EDW	Edwards AFB	Edwards	702	34	54	0	117	52	12	Kern	MDAB
EED	Needles	Needles	302	34	46	6	114	37	30	San Bernardino	MDAB
EMT	El Monte	El Monte	91	34	4	12	118	2	0	Los Angeles	SoCAB
FAT	Fresno	Fresno	102	36	46	36	119	43	0	Fresno	SJVAB
FFZ	Mesa, Arizona	Mesa, Arizona	424	33	27	36	111	43	36	Arizona	Arizona
FHU	Fort Huachuca, Arizone	Ft. Huachuca, Arizona	1438	31	35	18	110	20	36	Arizona	Arizona
FLG	Flagstaff, Arizona	Flagstaff, Arizona	652	35	8	0	111	40	0	Arizona	Arizona
FUL	Fullerton	Fullerton	29	33	52	12	117	58	54	Orange	SoCAB
GBN	Gila Bend, Arizona	Gila Bend-Arizona	237	32	57	30	112	40	42	Arizona	Arizona
GCN	Grand Canyon	Grand Canyon-Arizona	649	36	3	0	112	8	0	Arizona	Arizona
HHR	Hawthorne	Hawthorne	19	33	55	24	118	20	6	Los Angeles	SoCAB
IGM	Kingman, Arizona	Kingman, Arizona	1051	35	15	24	113	56	24	Arizona	Arizona
IPL	Imperial	Imperial	-16	32	50	12	115	34	30	Imperial	SSAB
IWA	Williams Air Force Base, Arizona	WAFB	377	33	16	0	111	48	54	Arizona	Arizona

IZA	Santa Ynez	Santa Ynez	205	34	36	30	120	4	30	Santa Barbara	SCCAB
KBAB	Beale Air Force Base NEXRAD		72	39	29	33	121	36	30	Yuba	SVAB
KEKA	Eureka NEXRAD	Eureka	766	40	29	55	124	17	27	Humboldt	NCAB
KEKO	Elko, Nevada NEXRAD	Elko	2088	40	44	24	116	48	6	Nevada	Nevada
KFAT	San Joaquin Valley NEXRAD	Hanford	100	36	18	49	119	37	52	Kings	SJVAB
KFLG	Flagstaff, Arizona NEXRAD	Flagstaff, Arizona	2220	35	7	32	111	32	52	Arizona	Airzona
KGJT	Grand Junction, Colorado NEXRAD	Grand Junction, CO	3064	39	3	44	108	12	44	Colorado	Colorado
KLAS	Las Vegas, Nevada NEXRAD	Las Vegas	1505	35	42	4	114	53	30	Nevada	Nevada
KLAX	Los Angeles NEXRAD	Los Angeles	854	34	24	42	119	10	43	Los Angeles	SoCAB
KMFR	Medford, Oregon NEXRAD	Medford	2305	42	4	52	122	42	58	Oregon	Oregon
KRIV	March Air Force Base NEXRAD	Riverside	430	33	35	54	117	7	10	Riverside	SoCAB
KRNO	Reno NEXRAD	Reno, Nevada	2558	39	45	15	119	27	31	Nevada	Nevada
KSAC	Sacramento NEXRAD	Sacramento	8	38	31	0	121	30	0	Sacramento	SVAB
KSAN	San Diego NEXRAD	San Diego	318	32	55	8	117	2	28	San Diego	SDAB
KSFO	San Francisco NEXRAD	San Francisco	1075	37	9	19	121	53	35	San Francisco	SFBAAB
KSLC	Salt Lake City, Utah NEXRAD	Salt Lake City, Utah	2004	41	15	45	112	26	48	Utah	Utah
KTUS	Tucson, Arizona NEXRAD	Tucson, Arizona	875	31	57	25	110	53	56	Arizona	Arizona
KVBG	Vandenberg Air Force Base NEXRAD	Vandenberg	396	34	50	17	120	23	45	Santa Barbara	SCCAB
KVCV	Edwards Air Force Base NEXRAD	Boron	870	35	5	52	117	33	36	Kern	MDAB
KVTX	Sulphur Mountain NEXRAD	Ojai	856	34	24	43	119	10	44	Ventura	SCCAB
KYUM	Yuma, Arizona NEXRAD	Yuma, Arizona	82	32	39	45	114	36	35	Arizona	Arizona
L27	Avalon	Santa Catalina Island	42	33	21	0	118	19	0	Los Angeles	SoCAB
L63	Indian Springs, Nevada	Indian Springs, Nevada	290	36	35	0	115	40	0	Nevada	Nevada
LAS	Las Vegas, Nevada	Las Vegas, Nevada	663	36	5	0	115	9	12	Nevada	Nevada
LAX	Los Angeles Airport	Los Angeles	38	33	56	36	118	24	24	Los Angeles	SoCAB
LGB	Long Beach	Long Beach	17	33	49	6	118	9	0	Los Angeles	SoCAB
LSV	Nellis Air Force Base, Nevada	Nellis AFB, Nevada	569	36	15	0	115	2	0	Nevada	Nevada
LUF	Luke Air Force Base, Nevada	Luke AFB, Nevada	102	33	33	0	112	22	0	Nevada	Nevada
MHV	Mojave Airport	Mojave	850	35	3	30	118	9	0	Kern	MDAB
MWS	Mount Wilson	Mount Wilson	1739	34	13	30	118	3	0	Los Angeles	SOCAB
MXL	Mexicali	Mexicali	7	32	37	33	115	13	25	Mexico	Mexico
MYF	Montgomery Field	San Diego	125	32	48	0	117	6	0	San Diego	SDAB
NFG	Oceanside Camp Pendleton	Oceanside	19	33	13	0	117	24	0	San Diego	SDAB
NID	China Lake Naval Warfare Center	China Lake	681	35	41	0	117	41	0	Kern	MDAB
NJK	El Centro	El Centro	14	32	49	0	115	40	0	Imperial	SSAB

NKX	Miramar National Weather Service Launch	Miramar Soledad Fwy	137	32	52	43	117	7	25	San Diego	SDAB
NLC	Lemoore	Lemoore	73	36	20	0	119	57	0	Kings	SJVAB
NRS	Imperial Beach	San Diego	8	32	34	0	117	7	0	San Diego	SDAB
NSI	San Nicolas Island	San Nicolas Island	14	33	14	0	119	27	0	Ventura	SCCAB
NTD	Point Mugu NAS	Point Mugu	2	34	7	12	119	7	0	Ventura	SCCAB
NTK	Tustin MCAS	Tustin	5	33	42	0	117	49	48	Orange	SoCAB
NUC	San Clemente Island Airport	San Clemente	55	33	1	0	118	35	0	San Diego	SDAB
NXP	29 Palms	29 Palms	581	34	7	48	115	56	36	San Bernardino	MDAB
NYL	Yuma, Arizona	Yuma, Arizona	65	32	39	24	114	36	18	Arizona	Arizona
NZJ	El Toro MCAB	El Toro	117	33	42	0	117	42	0	Orange	SoCAB
NZY	San Diego North Island	San Diego	15	32	43	0	117	12	0	San Diego	SDAB
ONT	Ontario	Ontario	290	34	3	22	117	36	11	San Bernardino	SoCAB
OXR	Oxnard	Oxnard	13	34	12	0	119	12	0	Ventura	SCCAB
P38	Caliente, Nevada	Caliente, Nevada	1483	37	36	0	114	51	18	Nevada	Nevada
P68	Eureka, Nevada	Eureka, Nevada	1815	39	36	0	116	0	18	Nevada	Nevada
PHX	Phoenix	Phoenix	345	33	26	12	112	0	30	Arizona	Arizona
PMD	Palmdale	Palmdale	774	34	38	0	118	5	0	Los Angeles	MDAB
POC	La Verne Brackett Airport	La Verne	305	34	6	0	117	47	0	San Bernardino	MDAB
PRB	Paso Robles	Paso Robles	255	35	40	24	120	37	36	San Luis Obispo	SCCAB
PRC	Prescott, Arizona	Prescott, Arizona	1537	34	39	6	112	25	12	Arizona	Arizona
PSP	Palm Springs	Palm Springs	146	33	50	0	116	30	0	Riverside	SSAB
PTV	Porterville	Porterville	135	36	1	48	119	3	42	Tulare	SJVAB
RAL	Riverside	Riverside	249	33	57	6	117	26	42	Riverside	SoCAB
RIV	March Air Force Base	Riverside	468	33	54	0	117	15	0	Riverside	SoCAB
ROSB	Santa Rosa Island B Met Site @ Elevation	Santa Rosa Island	396	33	59	20	120	5	43	Santa Barbara	SCCAB
SAN	San Diego	San Diego	5	32	44	0	117	11	12	San Diego	SDAB
SBA	Santa Barbara	Santa Barbara	6	34	26	0	119	50	0	Santa Barbara	SCCAB
SDB	Sandberg	Sandberg	1379	34	45	0	118	44	0	Los Angeles	SoCAB
SDM	San Diego Brown Field	San Diego	160	32	34	18	116	58	48	San Diego	SDAB
SEE	El Cajon Gillespie Airport	El Cajon	117	32	49	42	116	58	18	San Diego	SDAB
SLI	Los Alamitos	Los Alamitos	9	33	48	0	118	7	0	Orange	SoCAB
SMO	Santa Monica	Santa Monica	53	34	0	54	118	27	0	Los Angeles	SoCAB
SNA	Santa Ana	Santa Ana	16	33	40	30	117	52	0	Orange	SoCAB
TIJ	Tijuana	Tijuana	46	32	32	4	116	57	2	Baja, Mexico	Mexico
TOA	Torrance	Torrance	31	33	48	12	118	20	48	Los Angeles	SoCAB

TPH	Tonopah, Nevada	Tonopah, Nevada	1654	38	3	36	117	5	12	Nevada	Nevada
TRM	Thermal	Thermal	-33	33	38	0	116	10	0	Riverside	SoCAB
TUS	Tuscon, Arizona	Tuscon, Arizona	805	32	7	0	110	56	30	Arizona	Arizona
U31	Austin, Nevada	Austin, Nevada	1747	39	28	6	117	11	42	Nevada	Nevada
VBG	VANDENBERG AFB	VANDENBERG AFB	34	34	45	0	120	34	12	Santa Barbara	SCCAB
VIS	Visalia	Visalia	89	36	19	6	119	23	30	Tulare	SJVAB
VNY	Van Nuys	Van Nuys	244	34	12	36	118	29	18	Los Angeles	SoCAB
WJF	Lancaster	Lancaster	715	34	45	0	118	13	0	Los Angeles	MDAB
YUM	Yuma	Yuma	19	32	39	0	114	36	0	Arizona	Arizona

Table 3.2-9
NATIONAL PARKS SERVICE ROUTINE METEOROLOGICAL NETWORK

ID	Name	Address	City	(msl)	DD	MM	SS	DD	MM	SS	County	Air Basin
				Elev	Latitude			Longitude				
CHES	CHEESEBORO			503	34	11	5	118	43	2	Los Angeles	SoCAB
DVNM	Death Valley National Monument		DVNM	38	36	30	32	116	50	52	Inyo	GBVAB
FCBH	Beverly Hills	Franklin Canyon	Los Angeles	59	34	6	14	118	24	28	Los Angeles	SoCAB
GCAB	Grand Canyon	The Abyss-West Rim	Grand Canyon-Arizona	632	36	3	35	112	10	55	Arizona	Arizona
GCVC	Grand Canyon Visitor Center		Grand Canyon-Arizona	646	36	3	17	112	7	15	Arizona	Arizona
HUNT	Hunter Mountain		Inyo	2098	36	33	45	117	28	25	Inyo	GBVAB
JOSH	Joshua Tree National Monument	Black Rock Canyon	Black Rock Canyon	1244	34	4	15	116	23	27	San Bernardino	MDAB
KCGG	Kings Canyon	Grant Grove Vill	Kings Canyon	613	36	44	13	118	57	25	Fresno	SJVAB
LOST	Lost Horse Mountain		Lost Horse Mountain	1280	34	1	4	116	11	16	Imperial	SSAB
RATT	Rattlesnake Creek	near Window Cliffs	Window Cliffs	2622	36	24	42	118	25	18	Tulare	SJVAB
SBAR	SANTA BARBARA	Santa Barbara	Santa Barbara	54	33	29	0	119	2	0	Santa Barbara	SCCAB
SCIS	Santa Cruz Island		Santa Cruz Island	76	33	59	45	119	43	20	Santa Cruz	SCCAB
SQAM	Sequoia National Park	Ash Mountain #1	Sequoia NP	186	36	29	38	118	49	44	Tulare	SJVAB
SQAS	Sequoia National Park	Ash Mountain #2	Sequoia NP	159	36	29	56	118	49	26	Tulare	SJVAB
SQGF	Sequoia National Park	Giant Forest	Sequoia NP	580	36	34	1	118	46	33	Tulare	SJVAB
SQNP	Sequoia National Park	Lower Kaweah	Sequoia NP	576	36	34	1	118	46	40	Tulare	SJVAB
SRIS	SANTA ROSA ISLAND		Santa Rosa Island	396	33	58	40	120	4	40	Santa Rosa	SCCAB
SUGA	Sugarloaf Mountain		Cedar Grove	2476	36	43	36	118	40	30	Fresno	SJVAB
YMCM	Yosemite National Park	Camp Mather	Yosemie NP	437	37	53	20	119	50	27	Mariposa	MCAB
YMTD	Yosemite National Park	Turtleback Dome	Yosemie NP	1605	37	42	46	119	42	14	Mariposa	MCAB
YMWV	Yosemite National Park	Wawona Valley	Yosemie NP	390	37	32	34	119	39	32	Mariposa	MCAB

YOSE	Yosemite Village	Park Headquarters	Yosemie NP	372	37	45	0	119	35	13	Mariposa	MCAB

Table 3.2-10
UNITED STATES FOREST SERVICE ROUTINE METEOROLOGICAL NETWORK

ID	Name	Address	City	Site	(msl)	DD	MM	SS	DD	MM	SS	County	Air Basin
				ID	Elev	Latitude			Longitude				
APRT	ANGELES PORTABLE			323685B0	610	34	0	0	117	0	0	Los Angeles	SoCAB
BRMT	BRANCH MOUNTAIN			3247F476	1149	35	11	20	120	5	0	San Bernardino	MDAB
CHIL	Chilao Flat	Angeles National Forest	ANF	32486786	1662	34	20	0	118	2	0	Los Angeles	SoCAB
CMFS	CAMERON FIRE STATION		Cameron	326C332E	991	32	43	17	116	27	47	San Diego	SDAB
CONV	CONVERSE		Converse	3237D736	1712	34	11	1	116	55	1	San Bernardino	SoCAB
ELCR	EL CARISO		El Cariso	3230A392	926	33	39	6	117	24	24	Riverside	SoCAB
FAWN	FAWNSKIN	North Side of Big Bear Lake		3230F3EE	2103	34	15	58	116	53	56	San Bernardino	SoCAB
GLEN	Glen Annie		Santa Barbara	3247F476	232	34	28	24	119	52	10	Santa Barbara	SCCAB
KEEN	Keenwild	Mountain Center near Baldy Mountain	Mountain Center	32675560	1500	33	42	47	116	42	48	Los Angeles	SoCAB
LPRT	LOS PRIETOS			3267907E	311	34	32	9	119	47	0	Santa Barbara	SCCAB
MILL	Mill Creek Summit		Los Angeles	3248416A	1070	34	23	0	118	4	0	Los Angeles	SoCAB
MONT	MONTECITO		Santa Barbara	3237E2AC	457	34	27	6	119	38	6	Santa Barbara	SCCAB
MTLG	MT LAGUNA		Pine Valley	326B6166	1756	32	52	47	116	25	13	San Diego	SDAB
OAKG	Oak Grove	On the Way to Temecula		32309608	839	33	23	36	116	47	42	San Diego	SDAB
ROSE	Rose Valley Falls	near Rancho Grande	Rancho Grande	3242A3CA	1016	34	32	35	119	11	3	Ventura	SCCAB
SNMC	San Marcos Pass		Santa Barbara	3247E700	671	34	30	45	119	49	23	Santa Barbara	SCCAB
TANB	Tanbark Creek	San Dimas Station	San Dimas Station	324837FA	793	34	10	0	117	46	0	Los Angeles	SoCAB
WARM	Warm Springs Mountain	Warm Springs Mountain	Castaic	3248521C	1226	34	35	0	118	33	0	Los Angeles	SoCAB

Table 3.2-11
UNITED STATES NAVY ROUTINE METEOROLOGICAL NETWORK

ID	Name	Address	City	(msl)	DD	MM	SS	DD	MM	SS	County	Air Basin
				Elev	Latitude			Longitude				
HUEP	Port Hueneme		Oxnard	28	34	8	47	119	12	49	Ventura	SCCAB
LAGP	LAGUNA PEAK		Oxnard	134	34	6	31	119	3	55	Ventura	SCCAB
NSIN	San Nicolas Island		San Nicolas Island	9	33	15	36	119	34	20	Ventura	SCCAB
PMGU	POINT MUGU NAVAL AIR STATION		Point Mugu	1	34	6	36	119	7	12	Ventura	SCCAB
SCLH	San Clemente Island		San Clemente	592	32	52	33	118	25	57	San Diego	SDAB

SCRZ	Santa Cruz Island	Handar Station	Santa Cruz Island	450	33	59	43	119	38	6	Santa Cruz	SCCAB
SMIG	San Miguel Island	Handar Station	San Miguel	254	34	1	59	119	21	51	Santa Barbara	SCCAB

Table 3.2-12
UNITED STATES BUREAU OF LAND MANAGEMENT ROUTINE METEOROLOGICAL NETWORK

ID	Name	Address	City	Site	(msl)	DD	MM	SS	DD	MM	SS	County	Air Basin
				No.	Elev	Latitude			Longitude				
BARA	Baragan Wash		Hyder, Arizona	327D53AC	148	32	58	3	113	26	58	Arizona	Arizona
BEAR	Bear Peak		Little Lake	32554592	2509	35	53	3	118	3	6	Inyo	GBVAB
BIG	Big End	Big End State Recreation Area	BESRA, Nevada	325CA03C	305	35	7	30	114	42	30	Nevada	Nevada
BKRK	Black Rock	Wolf Hole Mountain West, Arizona	Black Rock Spring	327BB090	2159	36	47	25	113	44	50	Arizona	Arizona
BORO	Boron		Boron	3277B10C	882	35	5	39	117	34	55	Kern	MDAB
BRKL	Black Rock Lookout	Paiute Wilderness Area, Arizona	PWA, Arizona	324E11D8	2204	36	47	40	113	45	3	Arizona	Arizona
BURN	Burns Canyon		Yucca Valley	325775FC	1829	34	12	30	116	37	15	Kern	MDAB
CALI	Caliente Range		Caliente Range	325472F2	1349	35	5	20	119	48	45	San Luis Obispo	SCCAB
CARR	Carrizo Canyon		Carrizo Canyon	325472Z2	759	35	5	47	119	46	22	San Luis Obispo	SCCAB
CHRI	Christmas Tree Pass		Christmas Tree Pass	325077C8	1052	35	16	13	114	46	58	Nevada	Nevada
DELO	DELONAGHA		Lake Isabella	010345A6	951	35	34	12	118	37	0	Kern	SJVAB
FISH	Fish Creek Mountain	U.S. Naval Reserve south of Saltan Sea	USNR	3277A27A	232	32	59	0	116	3	28	Imperial	SSAB
FVML	FIVE MILE			324E02AE	1265	35	52	18	117	55	6	Inyo	GBVAB
GOOD	Goodwin Mesa		Goodwin Mesa, AZ	324C62BC	1280	34	45	0	113	18	0	Arizona	Arizona
GRAN	Granite Mountain		Lucern Lake	325254D0	1439	34	32	8	117	1	33	Santa Barbara	SCCAB
HAVA	Havasu-Needles	Whipples Crossing Neary Hwy 40	Needles	3279B564	145	34	47	14	114	33	42	San Bernardino	MDAB
HORS	Horse Thief Springs	Near Tecopa	Tecopa	325185B6	1524	35	46	14	115	54	33	San Bernardino	MDAB
HURR	Hurricane		Hurricane, Arizona	327B66F8	1616	36	45	0	113	15	0	Arizona	Arizona
INDE	Independence		Independence	3254B7EC	1305	36	50	12	118	14	40	Inyo	GBVAB
JWBN	Jawbone		Emerald Mountain	32538042	1311	35	17	41	118	13	35	Kern	MDAB
LRLM	LAURAL MOUNTAIN		Ridgecrest	324DF524	1338	35	28	42	117	41	56	Kern	SJVAB
MID	Mid Hills		Mid Hills	3254C17C	1650	35	9	58	115	24	55	San Bernardino	MDAB
MOHA	Mojave Mountain		Mojave	327A7774	1433	34	32	53	114	11	38	Kern	MDAB
MOJA	Mojave River Sink		Mojave	3277C79C	290	35	3	30	116	5	0	Kern	MDAB
MOSS	Moss Basin	near Kingman, Arizona	Kingman, Arizona	327D364A	1805	35	2	1	113	53	33	Arizona	Arizona
MOUN	Mount Logan	near Hurricane, Arizona	Hurricane, Arizona	324CA7A2	2195	36	20	50	113	11	56	Arizona	Arizona
MUSI	Music Mountain		Mohave, Arizona	3279707A	1768	35	35	48	113	48	22	Mohave	Arizona
NXFT	Nixon Flats Portab	Nixon Ranger Station	Trumbul & Tuweep, AZ	327C4220	1982	36	23	24	113	9	8	Arizona	Arizona

OLAF	Olaf knolls Mountain		Olaf Knolls Mtn, AZ	324C814E	884	36	30	0	113	49	0	Arizona	Arizona
OPAL	Opal Mountain		Opal Mountain	3257960E	988	35	9	20	117	11	0	San Bernardino	MDAB
PAHR	Pahrump, Nevada		Pahrump, Nevada	325CB34A	793	36	10	12	116	6	40	Nevada	Nevada
PANA	Panamint	near Death Valley National Monument	DVNM	3277D4EA	2098	36	7	0	117	5	0	San Bernardino	MDAB
PICA	Picacho Wash	near Obregon	Obregon	3277E170	256	32	57	0	114	43	56	Imperial	SSAB
RED	Red Rock	Linclon Memorial Shrine	Relands	32516644	1146	36	8	7	115	25	38	San Bernardino	SoCAB
SMIT	Smith Peak	Harcuvar Mountains	Arizona	327D7540	762	34	6	57	113	20	50	Arizona	Arizona
SMRV	Santa Maria River	near Pulmerita Ranch, Arizona	Pulmerita Ranch, AZ	327AF160	427	34	17	25	113	21	35	Arizona	Arizona
SQLK	Squaw Lake	near Old Senator Mine	Old Senator Mine	327C34B0	91	32	54	30	114	29	40	Imperial	SSAB
SQUA	Squaw Springs Well	near Red Mountain	Red Mountain	3256429C	1104	35	22	0	117	34	5	Kern	SJVAB
STWH	Sacatone Wash	near Opal Mtn & not Bridge Cyn nor Spirit Mtn	Opal Mountain	324DD3C8	665	35	34	25	114	40	28	Clark	Nevada
TOQU	Toquop Wash		Toquop Gap, Nevada	32567706	746	36	55	24	114	11	56	Nevada	Nevada
TWEE	Tweeds Point		Tweeds Point	324C9238	1585	36	35	0	113	43	0	Arizona	Arizona
UNIO	Union Pass		Union Pass	3277246E	1073	35	13	48	114	22	57	Arizona	Arizona
WALK	Walker Pass		Walker Pass	3253B5D8	1699	35	39	53	118	3	25	Kern	SJVAB
YELL	Yellow John Mountain		Arizona	325FB444	1878	36	9	15	113	32	30	Arizona	Arizona

Table 3.2-13

CCOHD & MCOHD ROUTINE METEOROLOGICAL NETWORK

ID	Name	Address	City	Site	(msl)	DD	MM	SS	DD	MM	SS	County	Air Basin
				No.	Elev	Latitude			Longitude				
BKJT	Henderson	Burkholder Junior High School	Lost Hills	320030005	594	36	1	51	115	8	38	Kern	MDAB
GLDL	Glendale	6000 West Olive	Glendale	40132001	357	33	34	8	112	11	23	Los Angeles	SoCAB
HDLM	Henderson	545 Lake Mead Drive	Henderson	320030007	579	36	1	44	114	59	20	Nevada	Nevada
LTFD	Litchfield Park		Glendale	40130009	325	33	27	21	112	21	28	Los Angeles	SoCAB
LVAP	Las Vegas	McCarran Airport	Las Vegas	320031007	668	36	4	40	115	10	4	Nevada	Nevada
LVCC	Las Vegas	City Center	Las Vegas	320030016	0	36	10	26	115	8	5	Nevada	Nevada
LVCH	Las Vegas	2850 E. Charleston Blvd	Las Vegas	320030557	567	36	9	32	115	6	35	Nevada	Nevada
LVEB	Las Vegas	280 E. Bonanza	Las Vegas	320031001	627	36	10	26	115	8	27	Nevada	Nevada
LVEC	Las Vegas	2801 E. Charleston Blvd	Las Vegas	320030010	567	36	9	32	115	6	35	Nevada	Nevada
LVES	Las Vegas	E. Sahara	Las Vegas	320030556	616	36	8	52	115	8	38	Nevada	Nevada
LVMS	Las Vegas	4701 Mitchell Street	Las Vegas	320030020	1922	36	14	41	115	5	31	Nevada	Nevada
LVSL	Las Vegas	625 Shadow Lane	Las Vegas	320030009	632	36	9	50	115	9	46	Nevada	Nevada
LVSR	Las Vegas	680 Sunset Road	Las Vegas	320031005	645	36	4	22	115	8	52	Nevada	Nevada
LVWW	Las Vegas	5483 Clubhouse Drive	Las Vegas	320030538	521	36	8	34	115	3	7	Nevada	Nevada

PENX	Phoenix	4202 Bellview	Phoenix	40130018	326	33	27	43	112	8	56	Arizona	Arizona
PH19	Phoenix	McDowell Road & 19th Avenue	Phoenix	40131008	330	33	27	54	112	5	56	Arizona	Arizona
PH47	Phoenix	47th Avenue & Osborn Road	Phoenix	40131006	348	33	30	39	112	7	47	Arizona	Arizona
PHAP	Phoenix	Sky Harbor Airport	Phoenix	40131007	339	33	25	44	112	1	4	Arizona	Arizona
PHER	Phoenix	1845 E. Roosevelt	Phoenix	40133002	340	33	27	32	112	2	34	Arizona	Arizona
PHFF	Phoenix	Falcon Field	Phoenix	40131010	0	33	27	17	112	4	22	Arizona	Arizona
PHIX	Phoenix	1740 W. Adams Street	Phoenix	40130014	327	33	26	56	112	5	49	Arizona	Arizona
PHN6	Phoenix	8521 N. 6th Street	Phoenix	40131004	379	33	33	39	112	3	53	Arizona	Arizona
PHWC	Phoenix	30 West Corona Avenue	Phoenix	40131005	328	33	24	21	112	2	27	Arizona	Arizona
PHWE	Phoenix	3847 W. Earll	Phoenix	40130019	334	33	29	2	112	8	31	Arizona	Arizona
PNIX	Phoenix	4732 S. Central	Phoenix	40130013	328	33	24	17	112	4	22	Arizona	Arizona
POEX	Phoenix	3315 W. Indian School	Phoenix	40130016	341	33	29	38	112	7	47	Arizona	Arizona
SUNC	Sun City	Thunderbird & Del Web	Sun City	40138001	358	33	38	13	112	17	31	Arizona	Arizona

Table 3.2-14

RAWS ROUTINE METEOROLOGICAL NETWORK

ID	Name	Address	City	Site	(msl)	DD	MM	SS	DD	MM	SS	County	Air Basin
				No.	Elev	Latitude			Longitude				
ACTN	Acton	Mountains South West of Acton	Acton	CA4A7044	792	34	26	45	118	12	0	Los Angeles	MDAB
AGRN	Arroyo Grande	Arroyo Grande near Lopez Lake	Arroyo Grande	CA2384AE	187	35	11	31	120	25	54	San Luis Obispo	SCCAB
ANZA	Anza	Anza	Anza	CA44C7A2	1195	33	33	18	116	40	23	Riverside	SoCAB
BELL	Bell Canyon	North East of San Juan Capistrano		CA4A93B6	213	33	32	30	117	35	30	Orange	SoCAB
BHIL	Beverly Hills	Franklin Canyon-Franklin Reservoire	Franklin Canyon	CA41E68E	384	34	7	30	118	24	44	Los Angeles	SoCAB
CASE	Case Springs	Between San Clemente and Temecula		92002544	707	33	26	43	117	25	5	San Diego	SDAB
CMP9	CAMP 9			CA41A584	1219								
CMPT	CMP TARGET RANGE			920010DE	280	33	22	20	117	21	32	San Diego	SDAB
DEVO	Devore	Near Crestline - West South West		CA44F238	634	34	13	16	117	24	11	San Bernardino	SoCAB
FSPR	Fountain Springs	Near Terra Bella		CA229522	64	35	53	32	118	54	54	Tulare	SJVAB
JULI	Julian	Julian	Julian	CA4A45DE	1292	33	4	33	116	35	27	San Diego	SDAB
LAPZ	La Panza	Los Padres National Forest	Panza Range	CA2397D8	497	35	22	52	120	11	15	San Luis Obispo	SCCAB
LTAB	Las Tablas	Near Naciemento Reservoire		CA23742A	497	35	39	20	120	55	22	San Luis Obispo	SCCAB
MHIL	Malibu Hills	Malibu	Malibu	CA4A73EC	480	34	3	30	118	38	0	Los Angeles	SoCAB
PFLD	Parkfield	Parkfield	Parkfield	CA2352C6	468	35	53	56	120	25	55	Monterey	NCCAB
POTR	Potrero	Near Mexican Border Between El Cajon & Pine Valley		CA4535DC		32	36	22	116	36	29	San Diego	SDAB
RANC	Ranchita	Near Borrego Springs	Borrego Springs	CA4526AA	1274	33	12	44	116	30	19	San Diego	SDAB
ROSP	Santa Rosa Plateau	Near Murrieta Hot Springs		CA4A6332	604	33	31	43	117	13	50	Riverside	SoCAB

SFDM	Santa Fe Dam	South West of Azusa and North East of Irwingdale		CA4A80C0	152	34	7	15	117	56	45	Los Angeles	SoCAB
SGUS	Saugus	Santa Clarita	Santa Clarita	CA418368	442	34	25	30	118	31	30	Los Angeles	SoCAB
SRPL	SANTA ROSA PLATEAU	South West of Murrieta Hot Springs		CA4A6332	604	33	31	43	117	13	50	San Diego	SDAB
TARG	CMP Target Range	Near Fallbrook	Fallbrook	920010DE	280	33	22	20	117	21	32	San Diego	SDAB
UHL	UHL	North West of Kernville just inside the Tulare County		3231429A	1134	35	48	0	118	36	0	Tulare	SJVAB
VLYC	Valley Center	Valley Center	Valley Center	CA451330	418	33	13	34	116	59	32	San Diego	SDAB
YCAV	Yucca Valley	Yucca Valley	Yucca Valley	CA450046	994	34	7	24	116	24	28	Riverside	SSAB

3.3 Supplemental Air Quality and Meteorological Measurements

The brief review of supplemental measurements during SCOS97-NARSTO provided here will allow data analysts and modelers to know what additional air quality and meteorological parameters were measured at each station. As noted before, there is significant overlap between supplemental ozone, aerosol, and NO_Y stations. To give a comprehensive overview, supplemental sites and parameters measured at each site are provided in Table 1.

Table 1 gaesous measurement columns are: ozone, nitrogen oxide, nitrogen dioxide, total reactive nitrogen, peroxy acetyl and peroxy propionyl nitrates, perchloro ethylene, methyl chloroform, nitric acid, nitrate ion, ammonia, carbon monoxide (CO), total hydrocarbons, methane (CH_4), non-methane hydrocarbons, CO-CH_4-carbon dioxide, speciated hydrocarbons with two to eleven carbon atoms, methyl tert-butyl ether, carbonyls, multi-functional oxygenated hydrocarbons, biogenic hydrocarbons [isoprene and terpenes], halocarbons, total reactive carbons, polycyclic aromatic hydrocarbons, fraction of radioactive carbon [fossil vs. newly fixed], and free radicals [OH, O_2H, O_2R]. Each measurement entry has detailed information that cannot be presented here. This table is meant to provide a guide to focus and to direct data analysts' and modelers' inquiries. The particulate matter columns are: aerodynamic diameter size 10 and 2.5 microns and all sizes. Please note that there is a wealth of important detailed information from the aerosol program available in section 3.6 of this volume. The radiation columns are: total solar radiation, light scattering, light absorption, ultra violet radiation, NO_2 dissociation light, and relative ultra violet radiation. More detail can be obtained from individual investigators at their world wide web sites or through reports when they are available for public dissemination. An explanation of instrument codes is provided at the end of Table 1.

The sites in Italic were aerosol sites that operated for only several weeks. It is important to note that Table 1 information on the aerosol program is only intended to provide those interested in particulate matter issues a better understanding of the generalities of SCOS97-NARSTO. Existing instruments are highlighted in Table 1.

Nitric acid measurements by the Tunable Diode Laser Spectroscopy (TDLAS) were unique to the Azusa station. The carbonyl intercomparison took place at the Azusa station. The EPA continuous gas-chromatography and the radio carbon group conducted their measurements at Azusa. Multi-functional carbonyls and total reactive carbon measurements are also unique to Azusa. The SCAQMD Azusa station can be considered the SCOS97-NARSTO supersite.

The supplemental meteorological measurements were added either to existing stations or were added to supplemental ozone, NO_Y, and aerosol network sites. These measurements are neither part of the Routine Network nor include other existing meteorological data resources. These measurements do not include surface meteorological measurements that accompany aloft stations such as radar wind profiler and radio acoustic sounding systems or sound detection and ranging instruments. Please note that there are many ways to describe wind speed and direction; Table 2 just notes availability of wind data in general. Please also note that the meteorological data from these stations have received more stringent quality assurance than is usually the case with similar data from the Routine Network. Table 2 is intended to provide a directory of quality determined surface meteorological data for analysts and modelers.

These two tables, the SCOS97-NARSTO Atlas and the data management guidelines communicated to investigators and study participants provide the best starting point for analysis and modeling of ozone and aerosol episodes.

Table 3.3-1
SUPPLEMENTAL AIR QUALITY MEASUREMENTS

SITE	Data Source		PARAMETERS																																		
			Gases																										Aerosols			Radiation					
ID	ID	Principal	O_3	NO	NO_2	NO_Y	PAN	PPN	PER	MCL	HNO_3	NO_3	NH_3	CO	THC	CH_4	NMHC	CO-CO_2 CH_4	$C_{2\text{-}11}$	MTBE	CRB	MCRB	BIO	HALC	TRC	PAH	RCB	OH	PM 10	PM 2.5	PM	TSR	BSP	BAP	UVS	JNO	RUV
29PM	US Marines	Helgeson, N	DAS	T42	T42	TCY					TCY								CAN	CAN	CAN																
ALPN	ARB-CHS	Stover, Cindy	DAS	CHM	CHM																								TOM	2-WK							
ALPN	SDCAPCD	Hossain, M															CAN				DNP																
ALPN	SDCAPCD	Hossain, M	DAS	TCY		TCY																															
ANAH	DRI	Zielinska, B	DAS	T42	T42									NIR	FID			CAN	CAN	CAN	DNP																
ARCO	CE-CERT	Fitz, Dennis	DAS														CAN				CAN																
ATAS	ARB-CHS	Stover, Cindy	DAS	CHM	CHM																								TOM	2-WK							
AZSA	CE-CERT	Fitz, Dennis									DDD		DDD																								
AZSA	CE-CERT	Fitz, Dennis			TDS						TDS																										
AZSA	CE-CERT	Fitz, Dennis	DAS	T42	T42	TCY					TCY																										
AZSA	CE-CERT	Fitz, Dennis												NIR	FID	SFD	CAN	CAN	CAN	CAN	CAN																
AZSA	DGA	Grosjean, D					GCE	GCE	GCE	GCE																											
AZSA	EPA	Lewis																									CAN										
AZSA	EPA	McClenny																	GCM	GCM																	
AZSA	SCAQMD	Barbosa, S												NIR			CAN				CAN																
AZSA	UC Davis	Charles, J																				IMS															
AZSA	UCLA	Paulson, S																							CTF												
AZSA	UCRiverside	Arey, Janet																								PUF/ TEN											
AZSA	UCRiverside	Arey, Janet										NTO																									
AZSA	UCRiverside	Arey, Janet																					TEN														
AZSP	Cal Tech	Cass, Glen									SFD		SFD																FLT	FLT							
AZSP	UCRiverside	Prather, Kim																													TMS						
BANN	CE-CERT	Fitz, Dennis	DAS	T4S	T4S	TCY					TCY																										
BANN	UCRiverside	Arey, Janet																					TEN														
BANN	UCRiverside	Arey, Janet										NTO																									
BARS	MDAQMD	Ramirez, B															CAN				CAN			GCC													
BARS	MDAQMD	Ramirez, B																								CAN											
BARS	MDAQMD	Ramirez, B	DAS	T42	T42	TCY					TCY																										

SITE	Data Source		PARAMETERS																																		
			Gases																										Aerosols			Radiation					
ID	ID	Principal	O_3	NO	NO_2	NO_Y	PAN	PPN	PER	MCL	HNO_3	NO_3	NH_3	CO	THC	CH_4	NMHC	$CO\text{-}CO_2$	$C_{2\text{-}11}$	MTBE	CRB	MCRB	BIO	HALC	TRC	PAH	RCB	OH	PM	PM	PM	TSR	BSP	BAP	UVS	JNO	RUV
																		CH_4											10	2.5							
BLKM	SDCAPCD	Hossain, M	DAS																																		
BRBK	DRI	Zielinska, B	DAS	T42	T42									NIR	FID		GCC	CAN	CAN	CAN	DNP																
BRBK	SCAQMD	Barbosa, S												NIR	FID		GCC		GCC		GCC																
CAJB	AeroVironm	Pankratz, D	DAS	T4Y	LPA	T4Y	LPA																														
CAJC	MDAQMD	Ramirez, B	DAS	T42	T42																																
CALB	AeroVironm	Pankratz, D	DAS	T4Y	LPA	T4Y	LPA																														
CATA	AeroVironm	Pankratz, D	DAS																																		
CATI	AeroVironm	Pankratz, D	DAS																																		
CATI	DRI	Zielinska, B																CAN	CAN	CAN	DNP																
CHIM	CE-CERT	Fitz, Dennis	DAS	MNL	MNL	TCY					TCY																										
CHIM	CE-CERT	Tuazon, E											FIR																								
CHIM	Cal Tech	Cass, Glen									SFD		SFD																FLT	FLT							
CHIM	Cal Tech	Cass, Glen											SFU																								
CHIM	UCRiverside	Prather, Kim																													TMS						
CHIN	ARB-CHS	Stover, Cindy	DAS	CHM	CHM																								TOM	2-WK							
CLMS	SDCAPCD	Hossain, M	DAS																																		
DIAM	CE-CERT	Fitz, Dennis	DAS	MNL	MNL	TSY					TSY																										
DIAM	Cal Tech	Cass, Glen									SFD		SFD																FLT	FLT							
DIAM	UCRiverside	Prather, Kim																													TMS						
EMAP	CE-CERT	Fitz, Dennis															CAN				CAN																
ESCO	SDCAPCD	Hossain, M	DAS											SIR																							
GLDR	ARB-CHS	Stover, Cindy	DAS	CHM	CHM																								TOM	2-WK							
HAWH	SCAQMD	Barbosa, S	DAS	T42	T42									NIR					CAN		CAN																
KRNM	SDCAPCD	Hossain, M	DAS	T42	T42									SIR			CAN		CAN		CAN																
LAGP	US Navy	Helvy, R	DAS																																		
LANC	ARB-CHS	Stover, Cindy	DAS	CHM	CHM																								TOM	2-WK							
LANC	MDAQMD	Ramirez, B	DAS	T42	T42																																
LANM	CE-CERT	Fitz, Dennis	DAS	T42	T42	T4Y					T4Y																										
LANM	CE-CERT	Fitz, Dennis															CAN				CAN																
LANM	Cal Tech	Cass, Glen									SFD		SFD																FLT	FLT							
LANM	UCRiverside	Arey, Janet																								PUF/ TEN											

SITE	Data Source		PARAMETERS																																		
			Gases																										Aerosols			Radiation					
ID	ID	Principal	O_3	NO	NO_2	NO_Y	PAN	PPN	PER	MCL	HNO_3	NO_3	NH_3	CO	THC	CH_4	NMHC	CO-CO_2	$C_{2\text{-}11}$	MTBE	CRB	MCRB	BIO	HALC	TRC	PAH	RCB	OH	PM	PM	PM	TSR	BSP	BAP	UVS	JNO	RUV
																		CH_4											10	2.5							
LANM	UCRiverside	Prather, Kim																													TMS						
LELS	ARB-CHS	Stover, Cindy	DAS	CHM	CHM																								TOM	2-WK							
LKAR	ARB-CHS	Stover, Cindy	DAS	CHM	CHM																								TOM	2-WK							
LOMP	ARB-CHS	Stover, Cindy	DAS	CHM	CHM																								TOM	2-WK							
MBLD	ARB-CHS	Schreiber, K	DAS	T42	T42									NIR																							
MBLD	UCRiverside	Arey, Janet																					TEN														
MEXI	DRI	Zielinska, B	DAS	T42	T42													CAN	CAN	CAN	DNP																
NLGB	ARB-CHS	Stover, Cindy	DAS	CHM	CHM																								TOM	2-WK							
OJAF	UCLA	Karlik, John																					TEN														
PEND	SDCAPCD	Hossain, M	DAS	T42	T42																																
PICO	SCAQMD	Barbosa, S	DAS	T42	T42									NIR	FID		GCC		GCC		GCC																
PINE	EPA	Lewis																									CAN										
PINE	UCRiverside	Arey, Janet																					TEN														
PMGU	US Navy	Helvy, R	DAS																																		
PTCL	DRI	Zielinska, B	DAS	T42	T42													CAN	CAN	CAN	DNP																
PVSP	AerVironm	Pankratz, D	DAS																																		
REDM	SDCAPCD	Hossain, M	DAS																																		
RICE	Port State	O'Brien, Bob	DAS	T42	T42														GCC	GCC	GCC							LIF									TRN
RIPR	Aerosol Dyn	Hering, S																													FRM						
RIPR	Aerosol Dyn	Hering, S																													FRM						
RIRD	CE-CERT	Fitz, Dennis																														BRW	NPH		EPP	PCH	
RIRD	CE-CERT	Fitz, Dennis																																ATH			
RIRD	CE-CERT	Fitz, Dennis																														LIC					
RIRD	CE-CERT	Fitz, Dennis																														EPP					
RIVC	Cal Tech	Cass, Glen								SFD		SFD																FLT	FLT							
RIVC	UCRiverside	Prather, Kim																													TMS						
ROSA	SBCAPCD	Murphy, T	DAS																																		
SMPK	SDCAPCD	Hossain, M	DAS																																		
SMSB	ARB-CHS	Stover, Cindy																											TOM	2-WK							
SNDM	ARB-CHS	Stover, Cindy	DAS	CHM	CHM																								TOM	2-WK							
SNIC	CE-CERT	Fitz, Dennis	DAS	TSY		TSY																															

SITE	Data Source		PARAMETERS																																		
			Gases																										Aerosols			Radiation					
ID	ID	Principal	O_3	NO	NO_2	NO_Y	PAN	PPN	PER	MCL	HNO_3	NO_3	NH_3	CO	THC	CH_4	NMHC	CO-CO_2	C_{2-11}	MTBE	CRB	MCRB	BIO	HALC	TRC	PAH	RCB	OH	PM	PM	PM	TSR	BSP	BAP	UVS	JNO	RUV
																		CH_4											10	2.5							
SNIC	DRI	Zielinska, B																CAN	CAN	CAN	DNP																
SOLM	SDCAPCD	Hossain, M	DAS	T42	T42	TCY					TCY																										
SOLM	SDCAPCD	Hossain, M															CAN				CAN																
SVAL	CE-CERT	Fitz, Dennis	DAS	T42	T42	TCY					TCY																										
SVAL	DGA	Grosjean, D					GCE	GCE	GCE	GCE																											
TCCC	SCAQMD	Barbosa, S	DAS																																		
TEHP	CE-CERT	Fitz, Dennis	DAS																																		
TIRP	DRI	Zielinska, B	DAS	T42	T42													CAN	CAN	CAN	DNP																
UCDC	ARB-CHS	Stover, Cindy	DAS	CHM	CHM																								TOM	2-WK							
UCDC	CE-CERT	Fitz, Dennis									DDD		DDD																								
UCDC	CE-CERT	Fitz, Dennis	DAS	T42	T42	TCY					TCY																										
UCDC	UCRiverside	Arey, Janet																								PUF/ TEN											
UCDC	UCRiverside	Arey, Janet										NTO																									
ULDS	ARB-CHS	Stover, Cindy	DAS	CHM	CHM																								TOM	2-WK							
VCEN	SDCAPCD	Hossain, M	DAS																																		
WILS	CE-CERT	Fitz, Dennis	DAS																																		
WILS	CE-CERT	Fitz, Dennis																														EPP					
WILS	CE-CERT	Fitz, Dennis																														BRW	NPH		EPP		
WSPR	SDCAPCD	Hossain, M	DAS																																		

METHOD	Method Description
2-Week	Two Week Filter Pack Sampler
ATH	Aethelometers
BRW	Brewer 280 to 320 & 420-510 nm
CHM	Chemilluminescence
CTF	cold trap & FID
DAS	Dasibi or API UV Photometry
DDD	Double Diffusion Denuder
DNP	DNPH/HPLC-UV
EPP	Eppley
FID	Continuous FID
FIR	FTIR
FLT	Filter Pack
FRM	Federal Reference Method
GCC	Continuous GC
GCE	Gas Chromotagraphy-ECD
GCM	Continuous GC & MS
IMS	PFBHA/Ion trap MS
LIC	Licor 300 to 850 nm
LIF	Laser Fluorescence
LPA	LPA-4 Luminox
MNL	Monitor Labs Chem Illuminesc
NIR	Non Dispersive Infra Red
NPH	Nepheleometer
NTO	NO3 plus PAH Reaction Products
PCH	PhotoChemilluminescence
PUF	Hi-vol and PUF plugs
RCB	Cryo & Radiation Detection
SDN	Stack Denuder
SFD	Stack Filter Diff Denuder
SFU	Stack Filteration Unit-Nucleopore
SIR	Infra Red Spectroscopy
T42	Theco 42 or API Chem Illuminesc
T4S	Theco 42S Chem Illuminesc
T4Y	Theco 42 converted Chem Illumin
TCY	Theco 42CY Chem Illuminesc
TDS	TDLAS
TEN	Tennex Cartridges
TOM	Tapered Element Oscilating Membrane
TMS	Time of Flight Mass Spectrometer
TRN	Transducer
TSY	Theco 42S converted Chem Illumin

Table 3.3-2
SUPPLEMENTAL SURFACE METEOROLOGICAL MEASUREMENTS

SITE	Data Source		PARAMETERS				
ID	ID	Principal	TMP	RH	DEW	WS	WD
BANN	CE-CERT	Fitz, Dennis	✓	✓			
BARS	MDAQMD	Ramirez, B	✓	✓		✓	✓
BLKM	SDCAPCD	Hossain, M	✓			✓	✓
CAJB	AeroVironm	Pankratz, D	✓		✓	✓	✓
CAJC	MDAQMD	Ramirez, B	✓			✓	✓
CALB	AeroVironm	Pankratz, D	✓		✓	✓	✓
CATA	AeroVironm	Pankratz, D	✓	✓		✓	✓
CATI	AeroVironm	Pankratz, D	✓	✓		✓	✓
CHIN	CE-CERT	Fitz, Dennis	✓	✓			
CLMS	SDCAPCD	Hossain, M	✓			✓	✓
DIAM	CE-CERT	Fitz, Dennis	✓	✓			
LAGP	US Navy	Helvy, R	✓			✓	✓
LANC	ARB-CHS	Stover, Cindy	✓	✓			
LELS	ARB-CHS	Stover, Cindy	✓	✓			
LKAR	ARB-CHS	Stover, Cindy	✓	✓			
LOMP	ARB-CHS	Stover, Cindy	✓	✓			
MBLD	ARB	Schreiber, K	✓	✓		✓	✓
PEND	SDCAPCD	Hossain, M	✓			✓	✓
PMGU	US Navy	Helvy, R	✓			✓	✓
PTCL	SBCAPCD	Murphy, T	✓			✓	✓
PVSP	AeroVironm	Pankratz, D	✓		✓	✓	✓
REDM	SDCAPCD	Hossain, M	✓			✓	✓
RIRD	Port State	O'Brien, Bob	✓	✓		✓	✓
RIVC	CE-CERT	Fitz, Dennis	✓	✓			
SMPK	SDCAPCD	Hossain, M	✓			✓	✓
SNIC	CE-CERT	Fitz, Dennis	✓			✓	✓
SOLM	SDCAPCD	Hossain, M	✓	✓		✓	✓
TEHP	CE-CERT	Fitz, Dennis	✓	✓		✓	✓
TEMC	SCAQMD	Barbosa, S	✓			✓	✓
UCDC	CE-CERT	Fitz, Dennis	✓	✓			
VCEN	SDCAPCD	Hossain, M	✓			✓	✓
WILS	CE-CERT	Fitz, Dennis	✓	✓		✓	✓
WSPR	SDCAPCD	Hossain, M	✓			✓	✓

3.4 Aloft Meteorological Measurements

The Routine Network in southern California includes meteorological resources aloft such as radar wind profilers and radio acoustic sounding systems – SCAQMD stations – Los Angeles and Ontario airports; the Ventura CAPCD station – Simi Valley; the San Diego CAPCD stations – Point Loma and Valley Center. During SCOS97-NARSTO additional units were added – ARB stations – the El Monte Airport and the Norton Air Force Base; the NOAA [William Neff] stations – Alpine Meteorological, Goleta, Los Alamitos, Port Hueneme, Carlsbad, Palmdale, San Clemente Island Meteorological, Santa Catalina Island Meteorological, Tustin, University of Southern California Meteorological, and the Van Nuys airport; the NOAA [M.J. Post] stations – Brown Field and El Centro; the Radian-STI stations – Barstow Meteorological, Riverside H.G. Mills Water District, Temecula East Municipal Water District, Thermal Airport, and Hesperia Oak Hills Center; the U.S. Air Force stations – three sites at Vandenberg Air Force Base. SCOS97-NARSTO sound detection and ranging instruments included the NOAA [William Neff] stations – Los Alamitos, Azusa Meteorological, Santa Clarita, and Vandenberg Air Force Base; San Diego CAPCD station – Warner Springs Meteorological; and U.S. Marines stations – two sites at 29 Palms. The RWP-RASS and sodar networks are listed in Tables 1 and 2. As it did before the study, NOAA still operates stations at Goleta and San Clemente Island.

The thirteen site rawinsonde network included the ARB station – Bakersfield Meteorological; the National Weather Service (NWS) station – Miramar; the military bases – 29 Palms, Edwards Air Force Base, China Lake, Tustin [El Toro operations moved to Tustin], San Nicolas, Point Mugu, North Island Naval Air Station [launch station moved to Imperial Beach], and Vandenberg Air Force Base, and the CE-CERT stations at UCLA, UC Riverside CE-CERT Facility, and Pomona. Meteorological parameters were available from seven ozonesonde site network from the CE-CERT stations – Anaheim, California State University at Northridge, Valley Center, Pomona, UC CE-CERT Facility, University of Southern California Hancock Building; and from the U.S. Navy station at Point Mugu. Tables 3 and 4 list the SCOS97-NARSTO sonde network. Currently, military and NWS still stations continue their rawinsonde operations as before SCOS97-NARSTO.

Before incorporating such a wealth of meteorological resources aloft, as the SCOS97-NARSTO provides, into modeling and data analysis, it may be found that data from some platforms at some locations would require further scrutiny. This section discusses collocated rawinsondes and profilers available to plan data comparisons. AeroVironment group's report already discusses methods, issues, and results of the comparison of sodar and profiler data. Both these types of data comparison are critical in preparing inputs for meteorological models; they are also critical for the kind of iterative quality control necessary to investigate new meteorological phenomena and to validate conceptual models of the southern California regional meteorology.

Rawinsonde and radar wind profiler-radio acoustic sounding (RASS) systems data can only be reasonably compared within the ground-based systems' radius of influence (Douglas et. al, 1997). Depending on the terrain of the profiler location and with the help of meteorological modeling resources, these radii can be determined. Data from elements of the rawinsonde network, close to but not exactly collocated with the profiler and within this radius, may then provide data for this type of comparison.

However, certain fundamental issues intrinsic to this type of comparison must be noted. Profiler-RASS systems produce statistical data. This means that for each elevation bin, each hourly value is a representative (e.g., mean or median) of at least five to ten values; these instruments can produce data at very small fractions of an hour. It may be more important to see how the rawinsonde data fit within the envelope of these values than how well the average profiler-RASS data agree with the instantaneous rawinsonde data (Figure 1-2b SAI report)(Douglas et. al, 1997).

Each platform also has uncertainties related to the different methods of measurement. For example, RASS uses the speed of sound through the air to measure temperature while rawinsonde thermistors record changes in the electrical resistance of their active element with respect to ambient temperature. RWP records a single vertical profile for wind data, while a rawinsonde reports wind data while it travels ten to thirty kilometers horizontally as it moves aloft. Differences between temperature data collected by nearly collocated rawinsonde, aircraft, and RWP-RASS instruments, available for August 1 and 4, 1992, at Hesperia (Figure 1-10a SAI report), illustrated the limits of interpreting these comparisons (Douglas et. al, 1997). The comparison indicated that the difference between the RASS and rawinsonde (located some distance away) data are no larger than those between aircraft and rawinsonde data. Apparently, differences in measurement technique as well as differences in location contributed to the difference between the data. It is important to understand the limits these factors impose on interpreting this type of data comparison.

To prepare data comparison plans, Table 5 provides a list of collocated meteorological aloft resources during SCOS97-NARSTO. Please note that ozonesondes only provided temperature and relative humidity data. Please also note that when the sites are close but not exactly collocated, the comparison couples are in italics. At Hesperia, the relative humidity lidar may have temperature and wind data which can be compared to the profiler-RASS data. At the El Monte airport, this type of comparison is restricted to the study kick-off celebration day.

Table 3.4-1
SCOS97-NARSTO RWP-RASS NETWORK

ID	Name	Address	City	Site No.	(msl)	DD	MM	SS	DD	MM	SS	County	Air Basin
				AIRS	Elev	Latitude			Longitude				
EMAM	El Monte Airport-RWP-RASS		El Monte		91	34	4	12	118	2	0	Los Angeles	SoCAB
NAFB	Norton Air Force Base		Norton AFB		320	34	9	12	117	15	0	San Bernardino	SoCAB
ALPM	Alpine-Met		Alpine		463	32	51	53	116	48	27	San Diego	SDAB
BRWN	Brown Field		Brown Field Airport		160	32	34	20	116	58	46	San Diego	SDAB
CARL	Carlsbad		Carlsbad		110	33	8	22	117	16	0	San Diego	SDAB
CATM	Santa Catalina-Met-USC Research Station	USC Research Station Near Isthmus	Santa Catalina Island		37	33	26	44	118	28	56	Los Angeles	SoCAB
ECNT	El Centro		El Centro		-15	32	40	12	115	29	20	Imperial	SSAB
GOLE	Goleta		Goleta		3	34	25	46	119	50	47	Santa Barbara	SCCAB
HUEN	Port Hueneme		Oxnard		2	34	9	54	119	13	8	Ventura	SCCAB
LOSM	Los Alamitos		Los Alamitos		7	33	47	18	118	2	56	Orange	SoCAB
PALD	Palmdale		Palmdale		777	34	36	46	118	5	26	Los Angeles	SoCAB
SCLM	San Clemente Island-Met		San Clemente Island		53	33	1	7	118	35	7	San Diego	SDAB
TUST	Tustin		Tustin		16	33	42	25	117	50	15	Orange	SoCAB
USCZ	USC-Hancock Fnd Bldg	3616 Trousdale Parkway	Los Angeles		67	34	1	10	118	17	2	Los Angeles	SoCAB
VNUY	Van Nuys Airport		Van Nuys		241	34	12	57	118	29	31	Los Angeles	SoCAB
BARM	Barstow-Met	12 Guage Lake-10000 Ming Avenue	Barstow		694	34	55	23	117	18	25	San Bernardino	MDAB
HESO	Hesperia-Oak Hills Center	19709 Yanan Road	Apple Valley		975	34	23	29	117	24	17	San Bernardino	MDAB
RIHM	Riverside-H.J.Mills Water District	550 E. Alessandro Blvd.	Riverside		488	33	55	0	117	18	30	Riverside	SoCAB
THRM	Thermal Airport	56860 Higgins Drive	Thermal		-39	33	38	25	116	9	35	Riverside	SoCAB
TMCM	Temecula-East Municipal Water District	P.O. Box 8300	San Jacinto		335	33	30	0	117	9	40	Riverside	SoCAB
LAXP	Los Angeles Airport		Los Angeles		47	33	56	24	118	26	10	Los Angeles	SoCAB
ONTP	Ontario Airport		Ontario		290	34	3	22	117	36	11	San Bernardino	SoCAB
ESCM	Valley Center Met-Miller Pumping Station	Valley Center Muni Water Dist-Dermid Rd End	Valley Center		305	33	15	19	117	2	40	San Diego	SDAB
PTLP	Point Loma	End of Propogation-Building 599	Point Loma		30	32	41	48	117	15	15	San Diego	SDAB
VBG	Vandenberg Air Force Base		Vandenberg AFB		364	34	45	0	120	34	12	Santa Barbara	SCCAB
SVLM	Simi Valley Met - Madero Road Landfill*	End of Madero Road North	Simi Valley	61110008	366	34	17	27	118	47	52	Ventura	SCCAB

Table 3.4-2
SCOS97-NARSTO SODAR NETWORK

ID	Name	Address	City	Site No.	(msl)	DD	MM	SS	DD	MM	SS	County	Air Basin
				AIRS	Elev	Latitude			Longitude				
AZSM	Azusa-Met		Azusa		232	34	9	37	117	54	17	Los Angeles	SoCAB
CLAR	Santa Clarita Valley		Santa Clarita		450	34	25	27	118	31	37	Los Angeles	SoCAB
WSPM	Warner Springs - Met Site	Hwy 79-Puerta La Cruz Road-1 mile from hwy	Warner Springs		945	33	19	5	116	41	3	San Diego	SDAB
VBG	Vandenberg Air Force Base		Vandenberg AFB		364	34	45	0	120	34	12	Santa Barbara	SCCAB
29PA	29 Palms-Sand Hill-Turtle Site	29 Palms Marines Base-Air Ground Combat Center	29 Palms		764	34	18	40	116	15	10	San Bernardino	MDAB
29PB	29 Palms-Expeditionary Air Field (<8/20/97)	29 Palms Marines Base-Air Ground Combat Center	29 Palms		610	34	17	50	116	9	47	San Bernardino	MDAB
29PC	29 Palms-Expeditionary Air Field (>8/20/97)	29 Palms Marines Base-Air Ground Combat Center	29 Palms		619	34	17	53	116	10	15	San Bernardino	MDAB
LOSM	Los Alamitos		Los Alamitos		7	33	47	18	118	2	56	Orange	SoCAB

Table 3.4-3
SCOS97-NARSTO RAWINSONDE NETWORK

ID	Name	Address	City	Site No.	(msl)	DD	MM	SS	DD	MM	SS	County	Air Basin
				AIRS	Elev	Latitude			Longitude				
BAKM	Bakersfield-Met	1031 Mount Vernon Avenue	Bakersfield		99	35	20	44	118	57	59	Kern	SJVAB
RIRD	Riverside-CECERT-Facility	1200 Columbia Avenue	Riverside		285	34	0	0	117	20	9	Riverside	SoCAB
UCLA	UCLA-Met-Math Science Building	425 N. Hilgard Ave-Circle Drive-West of Franz Hall	Los Angeles		122	34	4	11	118	25	59	Los Angeles	SoCAB
NKX	Miramar National Weather Service Launch	Kearny Villa Rd North 1 mile Soledad Fwy right gate	Miramar		137	32	52	43	117	7	25	San Diego	SDAB
POMA	Pomona-security concern-last IOP no PM launch	924 North Gary Avenue	Pomona	60371701	274	34	4	2	117	45	7	Los Angeles	SoCAB
EDWD	Edwards AFB		Edwards		723	34	54	0	117	54	0	Kern	MDAB
VBG	Vandenberg Air Force Base		Vandenberg AFB		364	34	45	0	120	34	12	Santa Barbara	SCCAB
29PD	29 Palms-Expeditionary Air Field	29 Palms Marines Base-Air Ground Combat Center	29 Palms		611	34	10	48	116	5	24	San Bernardino	MDAB
TUSR	Tustin MCAS		Tustin		17	33	42	0	117	50	0	Orange	SoCAB
CHLK	China Lake Naval Air Warfare Center	Armitage Field	China Lake		665	35	45	0	117	40	48	Kern	MDAB
NVAS	Naval Air Station-North Island	Halsey Field	San Diego		0	32	20	24	117	4	12	San Diego	SDAB
PMGU	Point Mugu Naval Air Station	Building 552	Oxnard		3	34	7	16	119	7	20	Ventura	SCCAB
SNIC	San Nicolas Island NE Bldg 279	Coastal Road to Building 279	San Nicolas Island		14	33	16	47	119	31	11	Ventura	SCCAB

Table 3.4-4
SCOS97-NARSTO OZONESONDE NETWORK

ID	Name	Address	City	Site No.	(msl)	DD	MM	SS	DD	MM	SS	County	Air Basin
				AIRS	Elev	Latitude			Longitude				
CSUN	Cal State Northridge	18111 Nordhoff Street-Building	Northridge		267	34	14	13	118	31	47	Los Angeles	SoCAB
USCZ	USC-Hancock Fnd Bldg	3616 Trousdale Parkway	Los Angeles		67	34	1	10	118	17	2	Los Angeles	SoCAB
VCNO	Valley Center-CE-CERT Ozone Sonde	29216 Valley Center	Valley Center		366	33	13	57	117	1	28	San Diego	SDAB
ANAH	Anaheim	1610 South Harbor Boulevard	Anaheim	60590001	45	34	6	0.9	117	29	31.5	Orange	SoCAB
POMA	Pomona-security concern-last IOP no night launch	924 North Gary Avenue	Pomona	60371701	274	34	4	2	117	45	7	Los Angeles	SoCAB
ULDS	Upland - moved after training	1350 San Bernardino Aven Sp 62	Upland	60711003	379	34	5	52	117	39	0	Riverside	SoCAB
ESCO	Valley Center (Escondido)	600 East Valley Parkway-	Escondido	60731002	204	33	12	57	117	7	43	San Diego	SDAB
PMGU	Point Mugu Naval Air Station	Building 552	Oxnard		3	34	7	16	119	7	20	Ventura	SCCAB

Table 3.4-5

SCOS97-NARSTO COLLOCATED METEOROLOGICAL RESOURCES ALOFT

Data Source		Data Comparison	Site Information		
Agency	Contact	Couple	Site Description	Site ID	Platform
CE-CERT	Kurt Bumiller	1	(Upland to) Pomona	ULDS to POMA	rawinsonde-ozonesonde
U.S. Marines	N. Helgeson	2	29-Palms Exped. Air Field	29PA	SODAR
U.S. Marines	N. Helgeson	2	29-Palms Sand Hills	29PB & 29PC	SODAR-rawinsondes
NOAA	Bill Neff	3	Central Los Angeles - USC	USCZ	RWP/RASS
CE-CERT	Kurt Bumiller	3	Univ. of So. Calif.	USCZ	ozonesonde
ARB-MLD	Reggie Smith	4	El Monte Airport	EMAP	RWP/RASS
CE-CERT	Kurt Bumiller	4	El Monte Airport	EMAP	rawinsonde for kick-off
SDCAPCD	Jean Timmerman	5	Escondido-ValleyCtr	ESCM	RWP/RASS
CE-CERT	Kurt Bumiller	5	Escondido-ValleyCtr	VCNO	ozonesonde
U.S. Navy	Roger Helvey	6	Point Mugu	PMGU	rawinsonde-ozoneson
Radian	George Frederick	7	Riverside-HJMills W.D.	RIHM	RWP/RASS
CE-CERT	Kurt Bumiller	7	Riverside-CE-CERT Facility	RIRD	rawinsonde
NOAA	Bill Neff	8	Tustin	TUST	RWP/RASS
U.S. Navy	Roger Helvey	8	Tustin	TUSR	rawinsonde
U.S. Air Force	Chris Crosiar	9	Vandenburg AFB	VBG	RWP/RASS-SODAR
U.S. Air Force	Chris Crosiar	9	Vandenburg AFB	VBG	rawinsonde
NOAA	*Bill Neff*	*10*	*Van Nuys Airport*	*VNUY*	*RWP/RASS*
CE-CERT	*Kurt Bumiller*	*10*	*CSU Northridge*	*CSUN*	*ozonesonde*
NOAA	*Bill Neff*	*11*	*San Clemente Island*	*SCLM*	*RWP/RASS*
NOAA	*Roger Helvey*	*11*	*San Nicolas Island*	*SNIC*	*rawinsonde*
NOAA	*Bill Neff*	*11*	*Santa Catalina Island*	*CATM*	*RWP/RASS*
U.S. Navy	*Roger Helvey*	*11*	*Weather Afloat*		*rawinsondes*
Radian	*George Frederick*	*12*	*Hesperia-Oak Hills Water*	*HESO*	*RWP/RASS*
Penn State	*Philbrick, C. R.*	*12*	*Hesperia-Oak Hills Water*	*HESL*	*Relative Humidity Lidar*

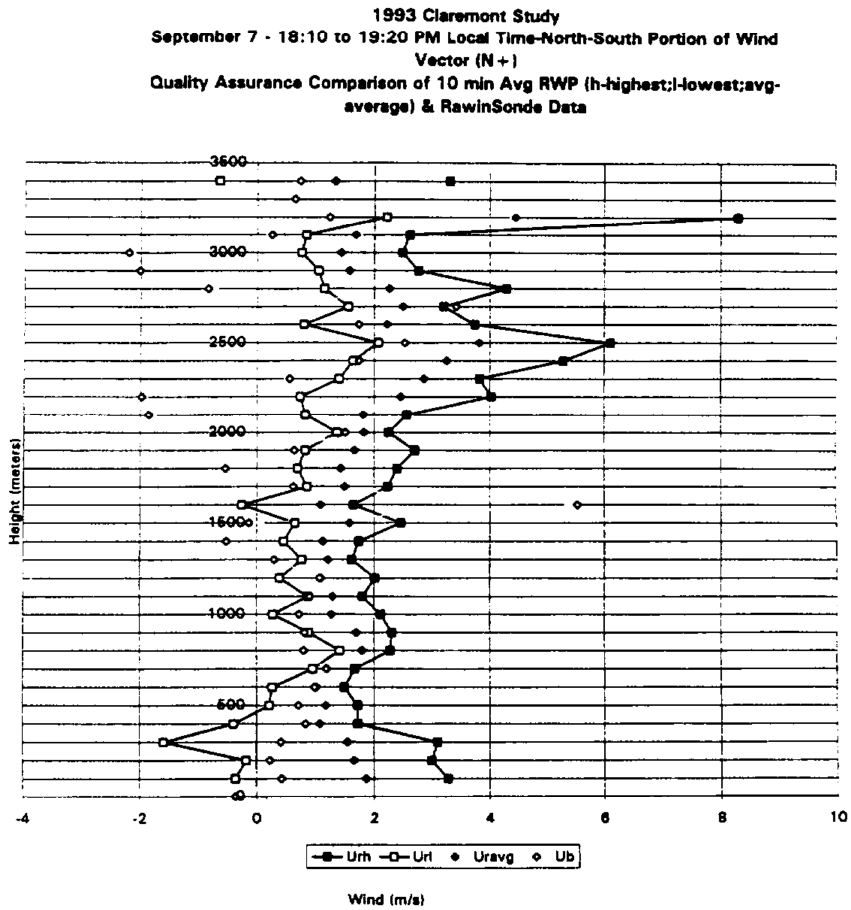

FIGURE 1-2b. Same as Figure 2-2a, but for the period 1810 to 1920 local time, 7 September.

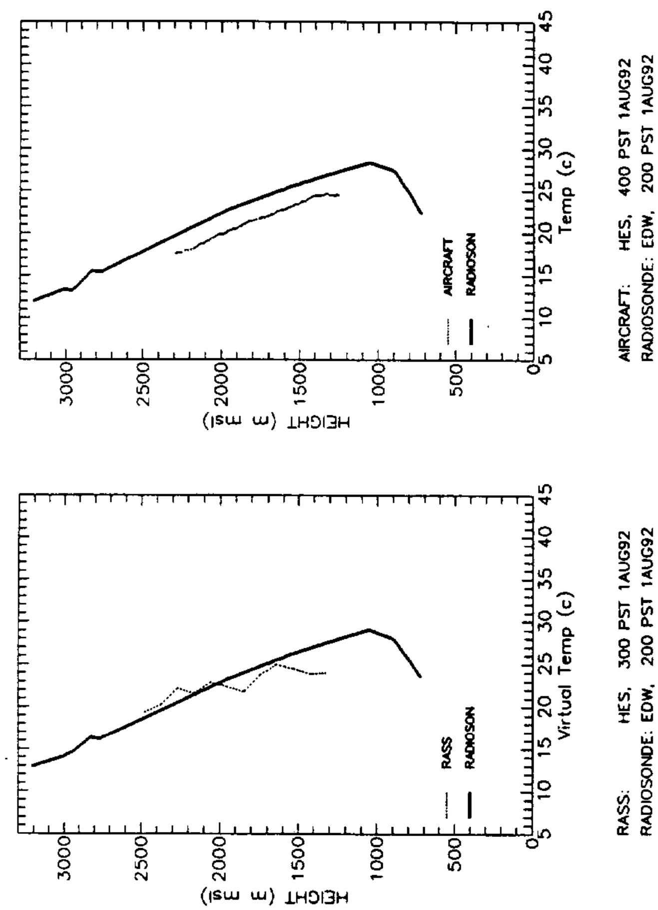

FIGURE 1-10a. Comparison of RASS and radiosonde derived virtual temperature for 1 August for HES (0300 PST) and EDWR (0200 PST) (left); comparison of aircraft and radiosonde derived temperature for 1 August for HES (0400 PST) and EDWR (0200 PST).

3.5 Air Quality Measurements Aloft

Characteristically, air pollution monitoring sites are located 3 - 10 meters above ground level in urban areas where the health impacts of air pollution are of greatest concern. However, to understand the formation and distribution of ozone on a regional scale, additional monitoring is needed in areas where the recirculation and transport of ozone and ozone chemical precursors may occur. This is especially important aloft, where the formation and distribution of ozone concentrations measured during previous studies in southern California are understood inadequately.

To better understand the vertical distribution of ozone on a regional scale, the SCOS97-NARSTO provided for an expanded network for air quality measurements aloft. These measurements aloft were made using six instrumented aircraft, seven ozonesonde release sites, and two ground-based lidars. The design of this network and the expected uses of these data are described below.

Data on air quality aloft were obtained during SCOS97-NARSTO by means of ozonesonde releases at seven sites, six aircraft, and two lidars. In addition, some supplemental surface monitoring sites were located on isolated peaks and a tall building to provide additional information related to air quality conditions aloft. These additional measurements provide critical detailed information pertinent to running and validating air quality models because the models can have difficulty simulating the observed vertical distributions of pollutants.

Because previous modeling efforts underestimated the amount of ozone in the central basin where ozone concentrations tend to be highest, the El Monte Airport, near the center of the basin, was established as the hub site for enhanced monitoring of conditions aloft. A 915-MHZ radar wind profiling system (RWP), operating throughout the June 16 through October 15 study period, and an ozone lidar, operating nearly continuously during the intensive periods, recorded data on the dynamics of ozone and meteorological conditions with height and time. Primarily on IOP days, these data were supplemented by measurements of ozone, oxides of nitrogen, temperature, humidity, and particles on up to nine aircraft spirals during daylight hours.

Previous studies demonstrated the complexity of air circulation offshore southern California and the importance of adequately characterizing the meteorological and air quality conditions there (e.g., Main *et al.*, 1990; Main *et al.*, 1991; Lehrman *et al.*, 1997). Air quality and meteorological monitoring offshore were greatly enhanced for the SCOS97-NARSTO; measurements were made aloft at several of these locations. During the IOPs, an instrumented aircraft (typically making morning and afternoon flights) provided additional, detailed data on conditions in the Southern California Bight during over-water sampling in an elliptical path encompassing the islands. On occasion, a second aircraft mapped the distribution of ozone concentrations inside the northeast quarter of the ellipse by sampling over the ocean west and southwest of Santa Monica Bay.

Lidar

Past air quality modeling applications have tended to underestimate ozone concentrations in the central portion of the air basin (typically, the region where ozone concentrations are highest). The primary objective of the ozone lidar in El Monte was to provide a continuous record of the development of ozone concentrations in this area. The lidar was located at the El

Monte Airport (see Figure 1). Ozone concentrations were monitored at ground level with a traditional ozone monitor and up to three kilometers with the differential absorption lidar (DIAL) using 266 nm as the on-line wavelength and 289 nm as the off-line wavelength. This lidar (Zhao *et al.*, 1994) has a larger range than other lidars because the laser energy is allocated among multiple parallel beams. The lidar's range resolution decreases from about 75 m at the bottom of the profile (150 m) to about 250 m near the top of the profile. The lidar also has a two-dimensional scanning capability in a vertical plane (NW to SE, perpendicular to the typical airflow in the region). These lidar data will be useful for 1) better understanding the dynamics of ozone formation in this area, 2) validating the performance aloft of modeling exercises, and 3) better quantifying ozone fluxes in the San Gabriel Valley.

Under the California Clean Air Act (Health and Safety Code, Section 39610) the transport of ozone (and ozone precursors) from one air basin to another is to be considered when evaluating the emission controls that might be necessary to bring an area into compliance with the California ambient air quality standard for ozone (1-hour average not to exceed 9 pphm). The upwind and receptor regions must control their emissions in a manner commensurate with their contribution to the ozone problem. With ozone concentrations in the SoCAB frequently violating the state and national ambient air quality standards and air typically flowing out of the SoCAB into neighboring air basins, quantification of ozone transport is a major concern. One of the major routes for airflow into the Mojave Desert is through Cajon Pass.

A lidar based on Raman shifts was positioned north of the Cajon Pass (see Figure 1) for a month beginning in late August. This lidar (Philbrick *et al.*, 1996) can measure water vapor, temperature, and aerosol scatter in addition to ozone. The temporal resolution of the water vapor and optical extinction profiles is about one minute while the temporal resolution for the ozone and temperature profiles is about half an hour. The water vapor data are obtained from the vibrational Raman scatter at 532 and 266 nm. The temperature data are obtained from the rotational Raman profiles of molecular nitrogen and oxygen. The optical extinction data are obtained from the gradients in the molecular nitrogen vibrational Raman profile. The ozone profiles are obtained from a DIAL analysis of the Raman shifted scatter of molecular nitrogen (285 nm) and molecular oxygen (276 nm). This lidar, because of its meteorological and ozone applications, will prove useful in understanding the meteorological dynamics influencing ozone transport.

Ozonesondes

Seven sites for releasing ozonesondes were established for the field study (see Figure 1). In principle, these sites collected data (by the potassium iodide method) on the vertical distribution of oxidant concentrations on a perimeter around the hub site at El Monte AP where the lidar provided nearly continuous ozone measurements during IOPs. Ozonesondes were released four times per day during IOPs. The release times were nominally 0200, 0800, 1400, and 2000 Pacific Daylight Time. The release times were offset from the rawinsonde releases (at 13 sites) by three hours to minimize the chances of signal interferences. In addition, the transmission frequencies of the ozonesondes (and their receivers) were modified in increments of 2 MHZ (between 400 and 406 MHZ) to reduce the possibility of a receiver locking onto the signal of another sonde if one were to drift into the vicinity of the receiver. The ozonesonde release sites were Pt. Mugu in Ventura County, California State University - Northridge (San Fernando Valley) and the University of Southern California in Los Angeles County, Anaheim in

Orange County, Pomona near the county line between Los Angeles and San Bernardino, the University of California-Riverside in Riverside County, and Valley Center in San Diego County.

Aircraft

Instrumented aircraft provided additional, detailed data on conditions aloft in the study domain, during IOPs and on some occasions the day before or after an IOP. Four aircraft were dedicated to the study and flew during the IOPs. Another aircraft, dedicated to mapping the distribution of ozone off the coast from Santa Monica Bay, was available to participate on about half of the IOPs. The sixth aircraft was dedicated to the aerosol component of SCOS97-NARSTO and flew on many days between late August and late September to characterize the 3-dimensional distribution of aerosols. This aircraft was equipped with an ozone analyzer and provided additional information on the relationships between particles and ozone. In general, each plane made morning and afternoon flights. Downward spirals were generally flown for characterizing the vertical distribution of pollutants. VOC and carbonyl samples were collected in altitude ranges not likely to include different air masses. Typical flight paths are portrayed in Figures 2 through 4.

The aircraft flights provided critical measurements of conditions aloft where carryover and transport of polluted air masses could significantly influence the performance of the model and influence pollutant concentrations at ground level. It is important that the air quality model application accurately simulate the ground level observations for the correct reasons. The over water flights are particularly critical to the success of the future modeling exercises because the upwind boundary conditions (i.e., the air quality flowing into the modeling domain). Ideally, the air quality should be "clean" of anthropogenic influences at the upwind boundary of the modeling domain. In southern California, the upwind boundary is generally the western boundary. Various measurement and modeling studies (e.g., Main *et al.*, 1990; Main *et al.*, 1991; Lehrman *et al.*, 1997; Edinger, 1973; Smith *et al.*, 1976; Johnson *et al.*, 1980; McElroy *et al.*, 1993; Lu *et al.*, 1996) have indicated that air circulations over southern California and the Southern California Bight are complex and that evidence of anthropogenic activity can routinely be found far offshore of the South Coast Air Basin.

Characterization of the air quality offshore is limited by cost, aircraft capabilities, safety, and even national security. The Southern California Bight includes test and exercise ranges for the U.S. military; when active, these military areas are off-limit to flight operations.

The primary objective of the Navajo was to make the ozone, NO_Y, and VOC measurements on the western boundary of the modeling domain and offshore. This aircraft was based out of Montgomery Field in San Diego County. The 4^+-hour flight would take generally take a clockwise elliptical route around the islands (i.e., south of San Clemente Island, south and west of San Nicolas Island, west, north, and east of the Channel Islands (San Miguel, Santa Rosa, Santa Cruz, and Anacapa Islands), and east of Santa Catalina Island) before returning to Montgomery Field (see Figure 2). Modifications to the flight plan were made during the study to reduce the duration of the flight to ensure adequate fuel reserves and to avoid military airspace when training areas were "hot". Spirals were made near San Clemente Island, San Nicolas Island, Pt. Conception, and Santa Catalina Island. VOC samples were collected below 500 feet MSL near San Clemente Island, below 500 feet and between 4500 and 6000 feet near San Nicolas Island, between 4500 and 6000 feet near San Miguel Island, and below 500 feet near Santa Catalina Island.

The primary objective of the Aztec was to provide data on conditions in the northern portion of the study domain (see Figure 2). These data are particularly important for establishing the initial conditions but also for characterizing boundary conditions under scenarios such as the Type 5 Episode where the northern boundary becomes the upwind boundary for the study domain. Typically, the Aztec would fly the northern leg of its flight plan (i.e., through the Mojave Desert) in the morning of the first day of an IOP (to characterize initial conditions) and return to its base airport in Camarillo in the afternoon by flying through the SoCAB (to characterize the vertical structure of ozone and oxides of nitrogen during the build-up day of the ozone episode). On the remaining days of an IOP, the flight path was reversed with a flight through the SoCAB in the morning (to identify carryover from the previous day) and a flight through the Mojave Desert in the afternoon (to identify any afternoon transport). Spirals (generally over airports) to clearly characterize the vertical distribution of pollutants were made (depending on the flight path) at Camarillo and Simi Valley in Ventura County; Rosamond, Hesperia, and Yucca Valley in the Mojave Desert; Santa Monica Bay (near Malibu), VanNuys, and El Monte in Los Angeles County; Ontario and Rialto in San Bernardino County; and Banning and Riverside in Riverside County. The Aztec generally collected a total of eight VOC and carbonyl samples each day of an IOP. The Aztec also served as a back-up for the Navajo on the western boundary route.

The primary objective of the Cessna 182 operating in the SoCAB was to provide data on conditions in the central portion of the basin (see Figure 3). Two to three flights were flown per day from the base airport at El Monte to Burbank Airport to Cable Airport (near Fontana in San Bernardino County), to Fullerton Airport (in Orange County), and back to El Monte Airport with spirals being flown at each location. The two spirals per flight at the El Monte AP provided "calibration checks" on the performance of the ozone lidar located there. Two VOC and carbonyl samples were collected per flight: one at El Monte AP between 1600 and 2600 feet and one at Azusa, also between 1600 and 2600 feet.

The primary objective of the Cessna 182 operating in San Diego County was to provide data on conditions in the southern portion of the study area and to identify any overland transport of ozone into San Diego County from the SoCAB (see Figure 3). The typical flight plan for this aircraft took it from its base at Montgomery Field to Alpine to Valley Center to Temecula, to Pine Mountain Camp to Warner Springs to Lake Henshaw to offshore of Oceanside to offshore Encinitas to Lake Hodges to Gillespie Field to Montgomery Field. Spirals were performed at Alpine, Valley Center, Temecula, Pine Mountain Camp, and Oceanside. Four VOC and thee carbonyl samples were generally collected per flight.

The primary objective of the Partnavia was to map the 3-dimensional distribution of ozone concentrations and the horizontal extent of any ozone layers encountered off the coast of Ventura and Los Angeles Counties (see Figure 3). This aircraft was based at the Oxnard AP and was only available if other groups had not already reserved it. The flight route was primarily inside the northeast quarter of the ellipse defined around the islands by the flight path of the western boundary aircraft (i.e., the Partnavia mapped ozone concentrations over the ocean west and southwest of Santa Monica Bay).

The primary objective of the Pelican (a single-engine pusher type of aircraft) was to map the 3-dimensional distribution of aerosols in the SoCAB (see Figure 4). This aircraft was also based at the El Monte AP. The plane contained three different types of aerosol analyzers and could generate detailed information on the size distributions of aerosols (between 0.005 and 47 microns). A secondary objective of the Pelican was to monitor ozone concentrations as it conducted its aerosol experiments.

Intercomparisons of air quality aloft measurements were made during SCOS97-NARSTO to evaluate the comparability of data from different platforms. The purpose of the intercomparisons was to identify and accurately quantify biases within (e.g., hysteresis in aircraft measurements) and between platforms. The University of California (Davis) aircraft served as a common link in the intercomparisons. The intercomparisons were scheduled so as not to interfere with activities during IOPs. Consequently, ozone concentrations during the intercomparisons generally were not as high as the sponsors desired.

3.6 Aerosol and Radiation Measurements

As discussed in section 2.3.2, ambient sampling was conducted at sites along two trajectories in the SoCAB (see Figure 3.6-1). To characterize the generation and evolution of urban aerosols, three sites [Los Angeles-North Main, Azusa, and the University of California at Riverside (UCR)] were selected along a trajectory from the emissions-rich central Los Angeles area, through the severely ozone-impacted San Gabriel Valley, and downwind to Riverside, the highest PM2.5 site in the SoCAB and perhaps the U.S. To characterize nitrate dynamics, measurements were made downwind of the most heavily populated portions of the Los Angeles coastal plain in Diamond Bar, immediately downwind of the ammonia-emitting dairy farms of the Chino Basin in Mira Loma, and further downwind in Riverside. To characterize the spatial and temporal variations in radiative quantities and photolytic rates attributable to scattering and absorption by aerosols, measurements were made at the surface in Riverside and above the mixed layer on Mt. Wilson (1725 m). The Riverside measurements were made at three sites on the University of California campus [Agricultural Operations (AgOps) monitoring station, College of Engineering-Center for Environmental Research and Technology (CE-CERT) rooftop, and Pierce Hall rooftop] within two miles of each other. The UCR sites were subject to approximately the same airmass, as verified with simultaneous ATOFMS measurements from June 29 to July 5, 1997.

Aircraft sampling over a wider area characterized vertical variations and the spatial extent of aerosol characteristics and irradiance observed along the trajectory. The flight paths are shown in Figures 3.6-1 and 3.6-2. To develop size distributions and composition profiles of fine particles emitted by gasoline- and diesel-fueled vehicles, measurements were made in the Caldecott Tunnel in northern California in November 1997. Table 3.6-1 lists all the participating measurement groups and Tables 3.6-2 through 3.6-4 contain a full listing of all the measurements collected.

Trajectory Study Measurements

Trajectory study collected continuous aerosol size distribution and composition data. simultaneously at three sites (see Table 3.6-2). U.C. Riverside measured real-time single particle size and chemical composition by Aerosol Time-of-Flight Mass Spectrometry (ATOFMS).

The new ATOFMS measurement technology permits sampling and experimentation (i.e., real-time measurement of the size and chemical composition of individual aerosol particles) that was previously prohibitively expensive or too time-consuming to be practical. ATOFMS can measure the aerodynamic size and chemical composition of up to 600 individual atmospheric particles per minute (50-100 under typical ambient conditions). These instruments permit direct observation of changes in ambient aerosols due to processes such as coagulation, condensation, evaporation, and heterogeneous gas/particle chemical reactions. Both the organic and inorganic content of individual aerosol particles can be determined. ATOFMS can be used to directly measure size and composition correlations for different particle sources, and to monitor particle transport and transformations. The ATOFMS measurements provide a wealth of data that will be used in development of source signatures for various PM sources, analysis of the temporal variation in aerosols at Riverside , and studies of aerosol chemistry in ambient air.

Aerosol Dynamics Inc. (ADI) conducted automated nitrate measurements at the Riverside Agricultural Station in August and at Mira Loma in September. Data were collected with 10 minutes time resolution over the entire measurement period. The analysis step took an additional minute, yielding 5 nitrate measurements per hour.

The ADI particle nitrate monitor provides automatic measurements using an integrated collection and vaporization cell. It has two modes of operation: sampling and analysis. In the sampling mode the sampled airstream passes through an impactor to remove particles above 2.5 µm, a denuder to remove interfering gaseous species and a humidifier to enhance particle collections. The particles in the airstream are then deposited by impaction onto a metal strip housed in the collection and vaporization cell. In the analysis mode the sample air flow is stopped. A carrier gas is introduced into the collection and vaporization cell and passes through the cell into the gas analyzer. The metal strip on which the particles have been deposited, located inside the cell, is rapidly heated by capacitor discharge. The heating process is less than a second. The deposited particles are vaporized and the evolved species are carried to a gas-phase analyzer for quantitation. By selection of the carrier gas and the amount of heating, a selected constituent of the deposited particles is converted to a gas-phase species that can be quantitated by a standard commercial analyzer. For automated nitrate analysis, particulate nitrate can be converted to nitrogen oxides, which can be analyzed by chemluminescence using a molybdenum converter. Ambient air is sampled at a flow rate of 1 liter per minute.

At each sampling site California Institute of Technology (Caltech) operated PM10 and fine particle filter samplers, two micro-orifice impactors (MOI), an electrical aerosol analyzer (EAA), an optical particle counter (OCP), and the data acquisition computer used for EAA and OPC. All sampling were in parallel with ATOFMS. The electrical analyzers were TSI (Minneapolis, MN) Model 3030 modified for increased sensitivity. The optical particle counter was Particle measuring Systems (Boulder, CO) Model ASASP-X 32 channel units.

Data from these electronic particle size monitors are currently being integrated for comparison with the mass distributions measured by impaction and the ATOFMS particle counting data. Real-time data from the OPCs and EAAs will be used to confirm the aerosol measurements of the MOI samples and the ATOFMS data. The filter-based samples were operated on the same 5-sample per day schedule (i.e., from 1 am to 6 am, 6:20 to 10 am, 10:20 am to 2 pm, 2:20 pm to 6 pm, and 6:20 pm to 1 am). The electronic samplers collected data continuously.

The filter samples are being analyzed to determine particle mass (PM10 and PM2.5), bulk composition (elemental carbon and organic carbon), and inorganic species concentrations (sulfates, nitrates, ammonium, chloride, and trace metals). In addition, denuder difference samples are undergoing analysis for nitric acid, and stacked filter samples for gas-phase ammonia. Two 48-hour average filter samples run in parallel collected enough particulate matter for quantification of trace organic species by gas chromatography/mass spectrometry (GC/MS). The fine particle samples are being analyzed for at least the approximately 50 organic compounds used for the source apportionment method developed at Caltech. The impactor samples are being analyzed to determine particle mass, bulk composition (elemental carbon and organic carbon), and inorganic species concentrations (sulfates, nitrates, ammonium, chloride, and trace metals) of the fine aerosol segregated into size fractions.

The College of Engineering-Center for Environmental Research and Technology (CE-CERT) at the University of California, Riverside, collected data on the concentrations of atmospheric nitrogenous species (NOy) which includes all species (e.g., nitrogen dioxide, peroxyacetyl nitrate [PAN], peroxypropyl nitrate [PPN], particulate nitrate, nitric acid, and nitrous acid).

At one site, Azusa, nitric acid and nitrogen dioxide were measured during ozone Intensive Operating Periods with a tunable diode laser absorption spectrometer (TDLAS). At Mira Loma ammonia was measured with a long-path Fourier transform infrared spectrometer (FT-IR) for two weeks, in early September. Denuder diffusion samples were also collected at these two sites over three hour intervals (from 10 am to 7 pm) to quantify nitric acid and ammonia. UC Riverside also collected PUF filters for PAHs and methylnitronapthalenes at all three sites for the first episode in August only. ARB collected 24-hour California Acid Deposition Program (CADMP) PM2.5 samples (mass and sulfate, nitrate, ammonium, chloride, sodium, potassium, calcium, and magnesium) at Los Angeles-North Main and Azusa for the two PM episodes in August.

Tunnel Study Measurements

The Caldecott Tunnel east of Oakland is uniquely configured with a center bore only open to passenger vehicles and side bores where trucks are shunted. Thus, the particulate matter concentrations in the center bore are dominated by light-duty gasoline vehicles, and the aerosol burden in the side bores are primarily due to emissions from heavy-duty diesel trucks. During the period November 17 through 21, four experiments were conducted with the ATOFMS and the Clatech's PM10 and fine particle filter samplers, two micro-orifice impactors, an electrical aerosol analyzer, an optical particle counter samplers (described above). To aid in data analysis and a carbon balance, the gas-phase precursors (i.e., CO, CO_2, speciated hydrocarbons, speciated carbonyl compounds, semi-volatile organic species) were sampled. An aerosol lidar was operated outside the tunnel. Data were also collected on fleet characteristics (e.g., count, speed, axles) to help in interpreting the results.

Fine Particle Measurement Study

The EPRI-sponsored Fine Particle Measurement Study was conducted at Riverside-AgOps from August 16 to September 22, 1997 (see Table 3.6-2 for a list of aerosol monitoring instruments). Both continuous and 24-hour-average samplers were deployed for the study, with duplicate side-by-side samplers installed when possible. Daily sample changes were made at 10:00 a.m. Pacific Daylight Time (PDT). The continuous aerosol nitrate monitor was operated at Riverside-AgOps during the first two weeks, after which time it was moved to the Mira Loma site. Other instruments were operated for the duration of the study.

Harvard University collected 24-hr samples by Harvard/EPA Annular Denuder System (HEADS), modified HEADS for inorganic ions, denuded filters for organic and elemental carbon, Harvard impactors for PM10 and PM2.5 mass, and FRM sampler for PM2.5 mass. Brigham Young University collected 24-hour samples for organics using their BOSS and BIG-BOSS systems, and for inorganic species using URG annular denuders and the R&P Chemspec automated denuder system. Real time instruments for particle mass included Harvard CAMMS, TEOM, and modified TEOM for PM2.5. Other real-time instruments were an aethelometer, ambient temperature nephelometer, ultraviolet wavelength particle absorption spectrometer, and, for the first two weeks, the ADI automated nitrate system. The same measurements were be made each day, with sample changes at 0600 PDT.

Experiments

1. Measure total fine particle mass by a single filter-based method (similar in principle to the FRM). This was coordinated with EPA to obtain their FRM data for comparison (Harvard Impactor).
2. Measure air concentration of total fine particle mass in situ by a continuous method where the loss of labile substances is minimal (Continuous Ambient Mass Monitor System: CAMMS).
3. Measure air concentrations of major ions and elements in gaseous and particulate form (with emphasis on gaseous nitrate and ammonia) as well as the amount of these substances which evaporate from filters during sampling using denuder-based sampling methods (HEADS).
4. Measure air concentrations of fine particulate organic and elemental carbon (OC and EC) including the amount of particulate organic material that evaporates from the filters during sampling using denuder-based sampling methods (Brigham Young Organic Sampling Systems: PC BOSS/BIG BOSS).
5. Measure particulate nitrate concentrations continuously in the field using a research-grade continuous analyzer (Aerosol Dynamics, Inc. Automated Particle Nitrate Monitor).
6. Quantify the evaporation of labile and volatile species from filters as a function of storage time, temperature, relative humidity and other factors using laboratory generated submicron particles containing ammonium nitrate and specific volatile organic compounds (e.g., glutaric acid).

The difference between Items 1 and 2 will characterize the magnitude of the error due to the loss of labile substances and Items 3 and 4 will enable quantitative explanations for this error. To characterize the precision of the observations and to deal with unplanned glitches in the field, each observable was measured via redundant multiple samplers.

Item 5 provides higher time resolution nitrate data (continuous 5- to 10-minute averages) as compared to the 12-hour nitrate data in Item 3. Such data are valuable in relating air concentrations to fluctuating meteorology, especially in urban areas such as Los Angeles, where nitrate concentrations are high and their contribution to fine PM is large.

Item 6 will provide the most direct and definitive proof that specific compounds evaporate from filters during the course of sampling and before chemical analysis.

The team was led by Professor Petros Koutrakis of Harvard School of Public Health (HSPH) (Items 1, 2, 3 and 6). Other experimenters were Prof. Delbert Eatough of Brigham Young University (BYU) (Item 4) and Dr. Susanne Hering of Aerosol Dynamics, Inc. (ADI) (Item 5).

Dr. Pradeep Saxena of EPRI is the Principal Investigator for planning and synthesis across all aspects of the study and in that role will contribute to writing of the results in policy-relevant form.

Riverside-AgOps was one of several, approximately five-week-long field sampling campaigns conducted at urban locations throughout the country during 1996 to 1998 as part of the EPRI study. These "snap shot" measurements in Birmingham, Boston, Riverside, Chicago, Dallas, Phoenix, and Bakersfield were designed to give an indication of the geographical and seasonal variability of the PM2.5 mass and composition. Comparison of mass and chemical data from continuous samplers (where loss of labile substances is believed minimal) with data from the more conventional filter-based methods (where losses may occur during or after sampling) will begin to characterize the magnitude of measurement error due to loss of labile substances. Another component of the study is evaluation of sampling methods in the laboratory, with tests aimed at understanding instrument precision, accuracy, and interferences or other limitations. The results of this multi-site/laboratory study will provide direct information on the magnitude of the loss of specific compounds and help guide the direction of future measurement research.

PM2.5 Federal Reference Method Nitrate Loss Measurements

The PM2.5 FRM Nitrate Loss Study was conducted in conjunction with the Trajectory Study. Two FRM samplers were operated side by side at each of the three Trajectory Study sites for the first four experiments.

In the December 1996 Federal Register, the Environmental Protection Agency states the design the design specifications for the proposed PM2.5 reference sampler. Prototype instruments have been constructed to these specifications by Graseby (Sumyrna, Georgia). These samplers contain a dichot inlet, a PM2.5 impactor with an oiled filter collection substrate, followed by a 47-mm Teflon filter. The FRM sampler is under positive flow control, i.e., using a small dry test meter to continuously monitor the flow volume, with a feed-back circuit to regulate the pumping speed. The sampler also has a fan to maintain the sampling chamber to within a few degrees of ambient temperature during sampling. All flow and temperature data are logged every five minutes during sampling period.

Daily sample changes were made at 1:00 a.m. PDT. At each site, one FRM unit collected particles on a Teflon filter and a second on a Teflon-nylon filter pack. Both types of filter packs were analyzed by ion chromatography. These results and those from collocated routine and research PM2.5 samplers will be used to quantify aerosol nitrate losses for the FRM.

Solar Radiation Measurements

The objectives of making radiation measurements, listed here in priority order, were to.

- Measure solar radiation and aerosol size, composition, and concentration and use the results to improve radiative transfer models suitable for calculation of spectrally resolved actinic flux.
- Compare diffuse and total irradiance observations from different types of broad band and spectrally resolved radiometers, and assess their utility for providing inputs for radiative transfer models or photochemical models.
- Provide observations if possible to help infer spatially resolved estimates of photolytic rates for an ozone episode of interest for the SCOS97-NARSTO domain.

The Radiation study built upon the extensive surface measurements of aerosol size, composition, and concentration detailed in Table 3.6-2 and the detailed characterization of aerosol size distributions aloft provided by the Pelican aircraft (described in the following section). With this foundation and in-kind services from several universities and agencies, relatively modest additional resources were required to collect a data set sufficient to examine interactions between aerosols and solar radiation.

Measurements of aerosols and of spectral and broad band irradiance were made, using identical or similar instruments, at two locations, the College of Engineering Center for Environmental Research and Technology (CE-CERT) in Riverside and at Mt. Wilson. Table 3.6-3 lists the instrumentation added specifically for the Radiation Study. Because Mt. Wilson was generally above the polluted mixed layer, the two sites provided contrasts in PM2.5, ozone, and trace gas concentrations and in the direct and diffuse solar radiation. Vertical profiles and horizontal distribution of aerosol size and concentration and of solar radiation were also provided by flights of the CIRPAS (Pelican) aircraft, described in the following section. Results from several key instruments listed in Table 3.6-3 will also be used to analyze the radiation results.

Temporal variation of the aerosol burden was observed by TEOM and ATOFMS at Riverside AO site, and by nephelometer and aetholometer at Riverside CE-CERT. Filter-based PM2.5 measurements were also made in Riverside. Video cameras recorded sky conditions at CE-CERT and Mt. Wilson.

Spectral irradiance was continuously observed at both sites using two different instruments, Brewer spectral radiometers operated at both sites by the University of Georgia and CE-CERT, and the Yankee ultraviolet multi-filter rotating shadowband radiometer (UVMFR), operated by the National Renewable Energy Laboratory from Colorado State University.

Broadband (total and diffuse) irradiance was continuously observed by CE-CERT at each site using pairs of duplicate radiometers (Eppley UV, Eppley PSP, and Eppley 8-48), operated both with and without shadowbands. These radiometers were chosen to match radiometers in widespread use in existing networks throughout southern California. For quality assurance purposes these radiometers were intercompared at Riverside prior to installation at Mt. Wilson. Radiometers from this group were also compared with the radiometers on the STI Aztec and the CIRPAS Pelican.

"Radiation intensive" days were selected for cloud free conditions, to coincide with episodes of ozone or PM, or to take advantage of special aircraft- and ground-based observations of aerosol size distributions and chemistry. These days included periods of light and heavy aerosol burden. On these days, CE-CERT operated an NO_2 actinometer to measure the photolytic rate for NO_2 and a LI-COR 1800 spectral radiometer with intermittent manual shading to measure spectrally resolved total and diffuse irradiance.

Intensives on August 27-28, September 4-6, 10, 12 were supported by the CIRPAS aircraft. By making spirals near CE-CERT and Mt. Wilson, the aircraft provided vertical profiles of irradiance and aerosol size and concentration for testing and improvement of models of radiative transfer. Intensive radiation measurements were also made on August 21-23 and October 30-November 1, but without the CIRPAS aircraft. An additional aircraft which flew during ozone IOPs did not measure aerosols, but did measure solar irradiance (Eppley PSP).

Aerosol Aircraft Measurements

For aerosol and radiation measurements aloft (see Table 3.6-4), the Pelican aircraft was operated by the Center for Interdisciplinary Remotely-Piloted Aircraft Studies (CIRPAS), a consortium of the Office of Naval Research, the Naval Postgraduate School, the California Institute of Technology, and Princeton University. Between August 27 and September 13, CIRPAS obtained measurements of the concentrations and size distributions of particulate matter and its constituent chemical species. The Pelican is a modified Cessna 337 Skymaster that has been reconfigured as a single engine pusher to allow sampling of unperturbed air from the front of the aircraft. With a standard payload of 330 lbs (150 kg) in an unobstructed nose cone, the Pelican can currently be operated in conventional on-board pilot mode. Wing hard points have been added to provide mounting pads for externally mounted payload pods or probes. Missions of approximately eight hours can be flown with on-board pilots flying over high population areas. During missions, real-time ground station access to scientific data and flight information from the Pelican is available via satellite data link. The airplane has a 43 ft wingspan and is 37 ft in length. The aircraft was housed at El Monte Airport in a hanger leased by Caltech.

The Pelican was designed to have the following capabilities:

- Optional piloting, i.e., conventional or as a remotely piloted aircraft (RPA)
- Endurance of up to 24 hours of RPA operations and 8 hours for onboard-piloted missions
- Range of 2500 km
- Mission altitude ranging from 20-4000 m
- Loiter speed as low as 40 m/s
- kg payload for 24-hour missions - 500 kg for 2-hour missions
- Fuselage nose volume of 1 m^3
- Main cabin payload volume (for on-board piloted missions) of 0.33 m^3
- Standard wing mounts for interchangeable pylon-mounted payloads at 50 kg each
- Palletized instrument capability
- Payload power = 1 kW at 28 V
- Satellite interactive communications for over-the-horizon operations

Aerosol size distributions in the range from 0.005 to 10 μm diameter were measured by an array of three instruments (RCAD, PCAS-100XP, and FSSP-300) with approximately 1-minute time resolution. PM2.5 particles were sampled using three parallel sampling trains that provided PM2.5 mass, elemental carbon, organic carbon, sulfates, nitrates, ammonium, chloride, and trace elements. Filter sampling for aerosol composition was performed on a 1-hour sampling duration. For a typical 8-hour flight mission, this allowed for about 7 to 8 series of filter samples per mission. The aircraft was also instrumented to monitor SO_2 and broadband solar and uv irradiance.

Flight Plans: Due to differences in the time resolutions of continuous and filter-based measurements, the Pelican flew two types of paths with different sampling objectives. The primary flight path (Figure 3.6-1) was designed to observe the three-dimensional evolution of aerosol size and concentration along the same west-to-east path as the first set of Trajectory Study experiments. This flight path consisted of spirals and traverses, and was designed to make use of continuous size and concentration measurements. A secondary flight path (Figure 3.6-2) was chosen to investigate nitrate dynamics aloft along the Trajectory Study path from Diamond Bar through the ammonia source area in the Chino Valley dairy district and on to the nitrate-rich aerosol found at Riverside. This path included traverses and constant altitude orbits to match the 1-hour sampling time for filter-based sampling that provides information on aerosol composition.

For spiral and traverse flight paths, a typical flight took 4 hours. Two flights per day were performed, with the morning flight starting at about 06:00 Pacific Daylight Time (PDT) and the afternoon flight starting at about 13:00 PDT. The spirals were made at locations where the Pelican aircraft could safely approach the ground, as close as possible to the intensive ground-level aerosol monitoring sites. Also, during intensive operational periods (IOPs) of SCOS97-NARSTO ozone program, the STI and UCD aircraft made measurements of VOC, NO, NO_x, NO_y, ozone, sulfur dioxide, particle light scattering, solar radiation, and meteorological parameters not only in the Pelican aircraft flight area, but broader area of southern California as well. Flight plans of multiple aircraft were conducted to have overlapping segments at least once per day to allow intercomparisons between the systems. For flights that occurred during IOPs for ozone episodes, the Pelican spiraled near the ozone lidar based at El Monte Airport at the start and end of the flight. The results will be used to intercompare the ozone and aerosol extinction measurements from both sampling platforms.

For 3-dimensional aerosol and radiation characterization (Figure 3.6-1), the Pelican took off from El Monte Airport to make an upward spiral then traverse to northern Santa Monica Bay where a downward spiral was made just offshore. Additional spirals were performed near Altadena, Azusa, Cable Airport, Rialto Airport, Riverside Municipal Airport, Chino Airport, Fullerton Airport, and Seal Beach. To document the horizontal gradients, traverses between spiral locations were at a constant altitude. The spiral near Altadena began near 1,000' above ground level and ascended to an altitude of about 7,000' -- well above the altitude of the Mt. Wilson observatory (5,791'). The upper levels of this spiral will be used to assess the aerosol load above the height of the solar radiation observations at Mt. Wilson. The lower levels of the Altadena spiral will allow a comparison with the observations from the spiral near Azusa. Additional ground-level radiation measurements were made at UC Riverside (CE-CERT) and at Mt. Wilson during August and September ozone and radiation IOP. Measurements were intended primarily to provide a data set suitable for evaluation of a radiative transfer model.

For the nitrate-oriented study (Figure 3.6-2), orbit flights were performed during a two-day episode of ground-level sampling (orbit is a circular or elliptical path flown at a constant altitude above a fixed point). Three sites -- Diamond Bar, Mira Loma, and UC Riverside -- were selected in the SoCAB to examine the formation of fine nitrate particles. The Mira Loma site was selected because there are large dairy farms just upwind (strong NH_3 source), and has a continuous air quality record since 1993 at the adjacent Jurupa Valley High School (Children's Health Study site).

The aircraft took off from El Monte Airport and made an upward spiral before traversing to Diamond Bar, Mira Loma, and UC Riverside. The Pelican aircraft flew repeatedly over the same path to provide sufficient sample time for collection of integrated samples for chemical analyses. A typical sampling duration was about one hour. The return traverse from Riverside to the El Monte Airport was from Riverside to Anaheim to offshore of Huntington Beach, then to Seal Beach, then inland northward back to the El Monte Airport, spiral down and land. The purpose of the indirect return path was to measure near surface aerosol concentrations over a greater area of the South Coast Air Basin, and especially to check transport along the Santa Ana river, which parallels the other major transport path between the Pacific ocean and Riverside . For the spiral, orbit, and traverse flight paths, a typical flight path took about 8 hours, allowing one flight per day.

Each of the six studies, discussed above, has a data analysis or modeling component. Many groups involved in the Aerosol Program, including EPRI, Harvard, BYU, SCAQMD, Caltech, and ADI, will be involved with comparisons among the various aerosol measurement methods.

Two of the more intensive efforts are for the Trajectory Study and the Radiation Study. The major objective of the Trajectory Study was to determine the relative contributions of sources such as gasoline engine exhaust, diesel exhaust, woodsmoke, food cooking aerosol, road dust, and secondary organic aerosol to PM2.5 concentrations in the SoCAB. To meet this objective, Professor Glen Cass of the California Institute of Technology will calculate source contributions to the fine organic aerosol concentrations and to overall primary fine particle mass concentrations at the three sampling sites for four of the two-day episodes. Source apportionment of fine organic aerosol and fine aerosol mass concentration will be achieved by applying a chemical mass balance model that relates source contributions to ambient PM2.5 concentrations using molecular markers. The chemical profiles of the emission sources were developed from the Tunnel Study and previous studies.

Efforts to evaluate and improve radiative transfer models suitable for simulating the effects of aerosols on photolytic rates will be led by Professors Robert Harley of the University of California at Berkeley and Nancy Brown of Lawrence Berkeley National Laboratory, and they will incorporate these results into existing photochemical models. In addition, the research instruments at CE-CERT and Mt. Wilson will be used to evaluate collocated broadband irradiance measurements to determine the utility of using existing networks of radiometers to aid in estimating semi-quantitatively the spatial and temporal trends and differences in photolytic rates across the SCOS97-NARSTO modeling domain.

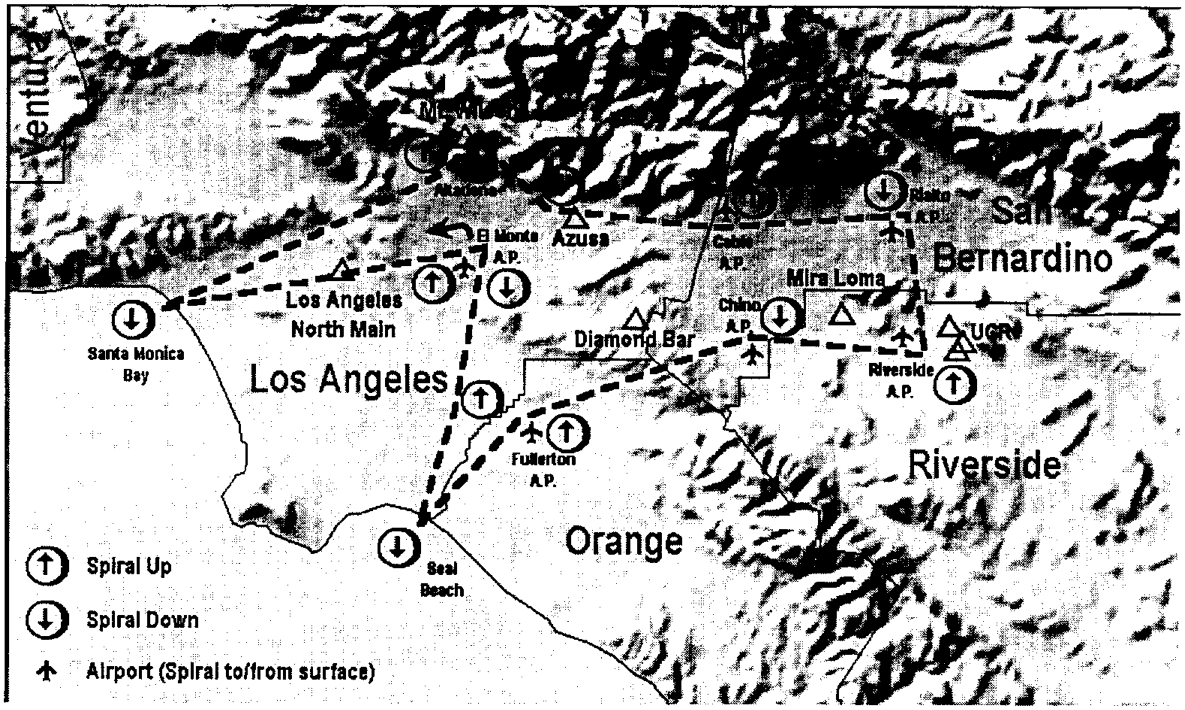

Figure 3.6-1. SCOS97-NARSTO Aerosol Program and Radiation Study surface sites with Pelican aircraft flight plan for 3-dimensional aerosol and radiation characterization.

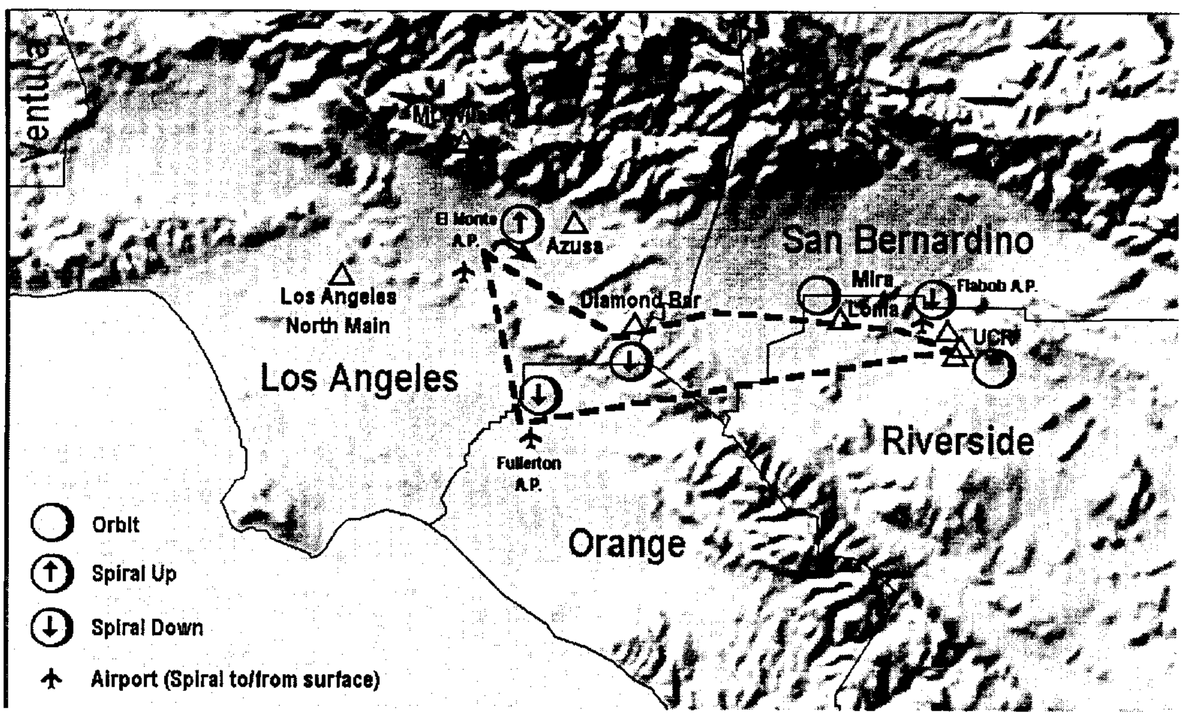

Figure 3.6-2. Pelican aircraft flight plan for nitrate aerosol characterization.

Table 3.6-1. SCOS97-NARSTO Aerosol Program and Radiation Study measurement groups.

Organization	**Investigators**
Aerosol Dynamics, Inc. (ADI)	Susanne Hering
Brigham Young University (BYU)	Delbert Eatough, Norman Eatough
California Air Resources Board (CARB)	Curtis Schreiber, Thelma Yoosephiance
California Institute of Technology (Caltech)	Glen Cass, Jonathan Allen, Lara Hughes, Philip Fine, Robert Johnson, Paul Mayo, Lynn Salmon
Center for Interdisciplinary Remotely Piloted Aircraft Studies (CIRPAS)	John Seinfeld, Richard Flagan, Haflichi Johnson, Mark Frolli, Paul Finn, Kenneth Liao, Lynn Russell
Colorado State University - National Renewable Energy Laboratory (CSU-NREL)	James Gibson, George Janson, William Durham
Desert Research Institute (DRI)	Barbara Zielinska, Larry Sheetz
Harvard University School of Public Health (Harvard)	Petros Koutrakis, George Allen, Mark Davey
South Coast Air Quality Management District (SCAQMD)	Rudy Eden, Steve Barbosa, Solomon Teffera, Mel Zeldin
University of California at Davis (UCD)	Debbie Niemeier, Britt Holmen, Judi Charles
University of California at Riverside - Department of Chemistry (UCR)	Kimberly Prather, Markus Gaelli, Eric Gard, Deborah Gross, and the rest of the Prather Group
University of California at Riverside - College of Engineering-Center for Environmental Research and Technology (UCR CE-CERT)	William Carter, Dennis Fitz, Michael McClanahan
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University of Georgia	John Rives, Wanfeng Mou

Table 3.6-2. SCOS97-NARSTO Aerosol Program instrumentation.

Organization	Parameter	Instrument	Duration	Site
Trajectory, Tunnel, and PM2.5 FRM Nitrate Loss Studies (sponsored by CARB, CRC, and NREL)				
ADI	NO_3^-	Automated nitrate monitor	continuous	ML
ADI	PM2.5 mass	FRM	24-hr (1 am start)	AZ, DB, LA, ML, PH
Caltech	PM2.5 organic species	Cyclone-filter sampler	5 samples/day	AZ, DB, LA, ML, PH, CD
Caltech	PM2.5 mass, EC, OC, $SO_4^=$, NO_3^-, NH_4^+, HNO_3, trace elements	Cyclone-filter with denuder sampler	5 samples/day	AZ, DB, LA, ML, PH, CD
Caltech	PM10 mass, EC, OC, $SO_4^=$, NO_3^-, NH_4^+, NH_3, HNO_3, trace elements	Cyclone-filter sampler	5 samples/day	AZ, DB, LA, ML, PH, CD
Caltech	Size-resolved aerosol (mass, $SO_4^=$, NO_3^-, NH_4, trace elements)	Micro-orifice impactor	5 samples/day	AZ, DB, LA, ML, PH, CD
Caltech	Size-resolved aerosol (mass, EC, OC)	Micro-orifice impactor	5 samples/day	AZ, DB, LA, ML, PH, CD
Caltech	Particle size, number	Electrical aerosol analyzer	continuous	AZ, DB, LA, ML, PH, CD
Caltech	Particle size, number	Optical particle counter	continuous	AZ, DB, LA, ML, PH, CD
DRI	CO, CO_2, C_1-C_{12} hydrocarbons, MTBE, C_1-C_7 carbonyl compounds, PAH	Canister and cartridge samplers	3-hr	CD
UCD	C_1-C_7 carbonyl compounds	Cascade and cartridge samplers	3-hr	CD
UCR	Size & composition of single particles	Aerosol time-of-flight mass spectrometer	continuous	AZ, DB, LA, ML, PH, CD
UCR CE-CERT	NO_y, HNO_3	TECO 42CY	continuous	AO, AZ, DB, LA, ML
UCR CE-CERT	NH_3, HNO_3	Denuder diffusion	3-hr (10 am-7 pm)	AO, AZ, DB, LA, ML
UCR SAPRAC	NH_3, HNO_3	Long-path Fourier transform spectrometer	continuous	ML
UCR SAPRAC	PAH	XAD-2 resin filter sampler	continuous	ML
Fine Particle Measurement Study (sponsored by EPRI and SCE)				
ADI	NO_3^-	Automated nitrate monitor	continuous	AO
BYU	PM2.5 mass	R&P FRM prototype	24-hr (10 am start)	AO
BYU	PM2.5 mass	TEOM sandwich prototype	continuous	AO
BYU	PM2.5 mass	TEOM with desiccation prototype	continuous	AO
BYU	PM2.5 mass, TC, $SO_4^=$, NO_3^-	Multi-channel samplers (PC/BOSS, BIG BOSS)	24-hr (10 am start)	AO
BYU	$SO_4^=$, NO_3^-, SO_2, HNO_3	Annular denuder/cyclone/filter sampler (Chem Spec)	24-hr (10 am start)	AO

Organization	Parameter	Instrument	Duration	Site
BYU	$SO_4^{=}$, NO_3^-, SO_2, HNO_3	Annular denuder/filter sampler (URG)	24-hr (10 am start)	AO
Harvard	$SO_4^{=}$, NO_3^-, NH_4^+, SO_2, NH_3, HNO_2, HNO_3, strong H^+	Annular denuder sampler (HEADS)	24-hr (10 am start)	AO
Harvard	PM2.5 and PM10 mass	Harvard impactor	24-hr (10 am start)	AO
Harvard	PM2.5 mass	CAMMS - filter pressure drop prototype	continuous	AO
Harvard	EC, OC	Carbon sampler, with and without gas phase stripper	24-hr (10 am start)	AO
Harvard	Light-absorbing aerosols	BC aethelometer	continuous	AO
Harvard	Light-absorbing aerosols	UV aethelometer	continuous	AO
Harvard	Light-scattering aerosols	Nephelometer	continuous	AO
Routine Monitoring Measurements				
CARB	PM2.5 mass, $SO_4^{=}$, NO_3^-, Cl^-, NH_4^+, Na^+, K^+, Ca^{+2}, Mg^{+2}	CADMP sampler	24-hr (6th day)	LA, AZ
SCAQMD	PM10 mass	TEOM	continuous	LA, AO, ML
SCAQMD	PM10 mass	BAM	continuous	LA
SCAQMD	O_3, NO_x, CO	Standard analyzers	continuous	AO, ML
SCAQMD	PM2.5 mass, $SO_4^{=}$, NO_3^-, Cl^-, NH_4^+, HNO_3, HCL, HCOOH, CH_3COOH	Two-week integrated sampler	two-week	AO, ML
SCAQMD	Light -scattering aerosols	Nephelometer	continuous	LA, AZ
SCAQMD	Light-absorbing aerosols	AISI tape sampler	continuous	LA, AZ
SCAQMD	PM10 mass, $SO_4^{=}$, NO_3^-, Cl^-	Hi-Vol SSI sampler	24-hr (6th day)	LA
SCAQMD	PM2.5 & PM10 mass and elemental species	Dichotomous sampler	24-hr (6th day)	LA
SCAQMD	PM10 and PM2.5 mass, EC, OC, $SO_4^{=}$, NO_3^-, Cl^-, NH_4^+, K^+, HNO3, trace elements	PTEP sampler	24-hr (6th day)	DB
SCAQMD	TSP mass, $SO_4^{=}$, NO_3^-	Hi-Vol sampler	24-hr (6th day)	LA, AZ

Sites
AO = UC Riverside - Agricultural Operations
AZ = Azusa
CD = Caldecott Tunnel
DB = Diamond Bar
LA = Los Angeles - North Main
ML = Mira Loma
PH = UC Riverside - Pierce Hall

Other
BAM = Beta Attenuation Monitor
CADMP = California Acid Deposition Monitoring Program
FRM = Federal Reference Method
Hi-Vol SSI = High Volume Size-Selective Inlet
PTEP = PM10 Technical Enhancement Program
TEOM = Tapered Element Oscillating Monitor

Table 3.6-3. Instrumentation at Mt. Wilson and Riverside for the SCOS97-NARSTO Radiation Study.

Mt. Wilson [1]	Riverside CE-CERT	Parameter	Instrument	Spectral Resolution; Range (nm)	Operator
Spectral Radiometers and Actinometer					
√	√	Spectral UV irradiance (and column O_3, NO_2, SO_2)	Brewer Spectral Radiometer	0.5nm; 286.5 - 363	CE-CERT/ U. Georgia
√	√	Total, direct, & diffuse spectral UV irradiance	Yankee UVMFR, multi-filter rotating shadow band	2nm; 300, 305.5, 311.5, 317.5, 325, 332.5, 368	CSU-NREL
√	√[2]	Total & diffuse spectral irradiance	LI-COR 1800 (& hand shading)	2nm; 300 - 1100	CE-CERT
√	√[2]	Rate of NO_2 photolysis	NO_2 Actinometer	broadband; 290-420	CE-CERT
Broadband Radiometers					
√	√	Total & diffuse UV irradiance	Eppley UV (& shadow band) [3]	broadband; 295-385	CE-CERT
√	√	Total & diffuse irradiance	Eppley PSP (& shadow band) [3]	broadband; 285-2800	CE-CERT
√	√	Total & diffuse irradiance	Eppley 8-48 (& shadow band) [3]	broadband; 285-2800	CE-CERT
Aerosol Measurements and Cameras					
√[4]	√[5]	Single particle size, composition	ATOFMS	N/A	UCR
√	√	Light-scattering aerosols	Nephelometer, Optec NGN-2	visible	CE-CERT
√	√	Light-scattering aerosols	Nephelometer, MRI 1590	visible	CE-CERT
√	√	Light-absorbing aerosols	AISI Tape Sampler (COH)	visible	CE-CERT
√	√	Light-absorbing aerosols	Aethelometer	visible	CE-CERT
√[6]	√	Visible sky conditions	Video Camera	visible	CE-CERT

[1] The original Mt. Wilson site was replaced and fully instrumented on August 21.

[2] Operated on June 29-July 5, August 21-23, 27-28, September 4-6, 10, 12, and October 30-November 1.

[3] Duplicate instruments, with and without shadowbands, operated at each site.

[4] Portable ATOFMS was operated at Mt. Wilson on initial radiation intensive days of June 29-July 5.

[5] Operated at UCR-Pierce Hall during all periods of intensive monitoring for radiation.

[6] Video camera operated by NOAA, looking southeast and downward on the mixed layer. Still camera operated by Portland State.

Table 3.6-4. Instrumentation on the CIRPAS Pelican.

Parameter	Instrument
Position	Trimble Navigation, TRNS Vector GPS
Altitude	Rockwell, radar altimeter
Aerosol size distributions, 0.005 to 0.15 μm, 45 channels, 1 min	Caltech, Radially Classified Aerosol Detector (RCAD), Differential Mobility Analyzer
Aerosol size distributions, 0.1 to 3.0 μm, 15 channels, 1 sec	Particle Measuring Systems, Passive Cavity Aerosol Spectrometer PCASP-100X
Cloud droplet size distributions, 0.5 to 47.0 μm, 15 channels, 1 sec	Particle Measuring Systems, Forward Scattering Spectrometer Probe, FSSP-100
Cloud droplet size distributions, 21 to 260 μm	Particle Measuring Systems, OAP-260X Spectrometer
Cloud droplet effective radius and liquid water content	PVM 100
Residual particles from evaporated cloud droplets ≤ 7 μm	Stockholm University, Counter-flow Virtual Impactor (CVI)
Light-scattering aerosols	TSI, multi-wavelength (450, 550, and 700 nm) integrating nephelometer
Dimethyl sulfide, carbonyl sulfide, and SO_2	RVM Scientific, automated gas chromatograph
Ozone	Dasibi, 1008-AH
One-hour integrated PM2.5 mass, EC, OC, $SO_4^=$, NO_3^-, Cl^-, NH_4^+, trace elements	Aerosol Dynamics, Inc., multichannel one-hour integrated PM2.5 sampler
Temperature (static)	Rosemont, 102
Pressure (static)	Rosemont, 1201
Pressure (dynamic)	Setra, 239
Dew Point	Edgetech, 137-C3 Hygrometer
Solar irradiance, downward and upward	Eppley PSP
UV irradiance, downward	Eppley UV

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